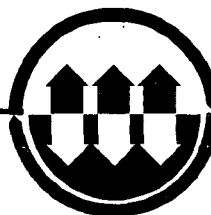


**SUBJECT
TO REVISION**

Construction Report

Leichner Brothers Landfill Closure



EMCON

DRAFT

**SUBJECT
TO REVISION**

Construction Report
Leichner Brothers Landfill Closure

Prepared for
Leichner Brothers Landfill
Vancouver, Washington
May 1993

Prepared by
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Project 0182-003.01

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**CONSTRUCTION REPORT
LEICHNER BROTHERS LAND FILL CLOSURE
MODULE 1B, 2, 3 (PHASE 1) AND PHASE 2 CONSTRUCTION
LEICHNER BROTHERS LANDFILL**

The engineering material and data contained in this report were prepared under the supervision and the direction of the undersigned, whose seal as a registered professional engineer is affixed below.



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EXECUTIVE SUMMARY

The Leichner Brothers Landfill Closure was constructed between November 1988 and October 1992, under two construction contracts.

The closure construction was performed to close the Leichner Brothers Landfill in compliance with WAC 173-304-460(3)(e) Minimum Functional Standards (MFS).

A construction quality assurance (CQA) program was established to document that work was performed in accord with the contract documents. The CQA program included full-time construction monitoring, field materials testing, field engineering services, and laboratory materials testing. The monitors and engineers observed construction, performed and coordinated materials testing, provided design clarifications during the work, and performed construction surveys.

This report includes descriptions of the CQA program, construction techniques, observations, materials testing results, and design modifications made during construction.

This report documents that the closure of the Leichner Brothers Landfill was constructed in accord with the closure plan, contract documents, their modifications, and the design intent.

1 INTRODUCTION

1.1 Project Description

This report summarizes closure construction for the Leichner Brothers Landfill. Closure took place under two construction contracts over a four-year period. The Phase 1 closure was the first contract; Phase 2 was the second contract.

The first contract, for closure construction was entitled "Leichner Brothers Landfill Modules 1B, 2, and 3 Closure Construction Project." It was awarded to Gilbert Pacific, Inc. Construction of the closure began in November of 1988 and was substantially complete by November 1989. This closure is referred to in this report as Phase 1.

The second contract for closure construction was entitled "Leichner Landfill, Phase 2 Closure Project." It was awarded to DELHUR Industries, Inc. Construction of the Phase 2 closure began on July 9, 1991, and was substantially complete by October 1, 1992. This closure is referred to in this report as Phase 2.

The Leichner Brothers Landfill is located in southern Clark County (see Figure 1) and covers approximately 70 acres of a 115-acre site. The site was operated by Leichner Brothers Land Reclamation Corporation.

The purpose of this report is to document that closure construction was completed in accord with the closure plan, the closure construction contract documents and the Washington Administrative Code [WAC 173-304-460(3)(e)] Minimal Functional Standards for Solid Waste Handling (MFS).

The report includes the following:

- Project Description
- Construction Personnel Organization
- General Construction Details
- Summary of Construction Quality Assurance Function
- Earthwork Quality Assurance
- Geosynthetics Quality Assurance
- Summary of Modifications During Construction
- As-Built Documentation and Quality Assurance Test Data Summaries

1.2 Reference Documents

The following reference documents provide background information related to closure of the site.

- "Leichner Brothers Landfill Storm Water Runoff Control Plan," prepared by Sweet-Edwards/EMCON, Inc., August 1987
- "Leichner Brothers Landfill Storm Water Outfall Report," prepared by Sweet-Edwards/EMCON, Inc., August 1989
- Leichner Brothers Landfill Master Plan, prepared by Sweet-Edwards/EMCON, Inc., February 1989.
- Contract Documents, Leichner Brothers Landfill Module 1B, 2, 3, Closure Construction Project, prepared by Sweet-Edwards/EMCON, Inc., August 1988.
- Contract Documents, Leichner Landfill, Phase 2 Closure Project prepared by Sweet-Edwards/EMCON, Inc., May 1991.

1.3 Related Work

A Storm Water Outfall was constructed as part of the landfill closure. It was completed in accord with the Storm Water Runoff Control Plan prepared by Sweet-Edwards/EMCON in August 1987. The purpose of the storm water outfall is to transmit storm water runoff collected from the closure area to Curtain Creek. The construction of the Storm Water Outfall is discussed in detail in the Leichner Brothers Landfill Storm Water Outfall Construction Report, prepared by Sweet-Edwards/EMCON, Inc., October 1989.

2 CONSTRUCTION PERSONNEL ORGANIZATION

This section of the report describes the parties responsible for the Leichner Brothers Landfill Phase 1 and Phase 2 closures. There were four primary parties: the owner, Leichner Brothers Land Reclamation Corporation; the engineer, EMCON Northwest (formerly Sweet Edwards/EMCON); and the contractors, Gilbert Pacific and DELHUR Industries, Inc. For the purpose of this report, we will refer to the parties as Owner, Engineer, and Contractor.

The Owner is the primary party responsible for the closure. That responsibility includes funding and overall project management.

The Engineer was the project designer. During construction, the Engineer was on site as the Owner's representative and provided resident engineering, construction contract administration, construction quality assurance services, and design and construction of the landfill gas collection system. EMCON Northwest subcontracted with other consultants to provide surveying, soils laboratory testing, and geosynthetics laboratory testing.

The Owner hired the Contractors to perform the work described in the construction contract. The Contractors then subcontracted specific elements of the work. All references to Contractor in this report mean the general Contractor, Gilbert Pacific, DELHUR Industries, Inc., or their subcontractors.

3 GENERAL CONSTRUCTION DETAILS

3.1 General Closure Description

Closure construction was performed to mitigate impact to groundwater by eliminating surface water infiltration to the landfill and to prevent off-site migration of landfill gases. The landfill was covered with an impermeable cover system, surface water drainage systems were constructed to divert storm water away from the landfill site, and gas collection and transmission systems were installed.

3.2 Landfill Gas Collection System

The landfill gas (LFG) collection system, constructed as part of the Phase 1 and Phase 2 closures was activated as the construction of each phase was completed. The north flare station and gas wells installed during Phase 1 construction were activated in the fall of 1989. The south flare station and wells were activated in two segments. The first segment was activated in November of 1991, following completion of a portion of Phase 2 construction. The second and final segment was integrated into the south flare gas system at the completion of the Phase 2 closure construction in October of 1992. The LFG system construction includes the following components:

- North and south flare stations
- Vertical extraction wells
- Gas transmission laterals
- Connectors
- Main transmission headers
- Condensate sumps

This following paragraphs describe the components. For construction details, see the record drawings.

3.2.1 Vertical Extraction Wells

Vertical extraction wells for landfill gas extraction consist of vertically drilled borings into the refuse. A PVC pipe is inserted into the boring. The PVC pipe is perforated at various design depths, and the perforated sections of the boring are backfilled with clean-washed gravel. A bentonite seal is placed over the gravel backfill, and the remainder of the boring is backfilled with soil. The record drawings show the well locations and their depths.

3.2.2 Gas Transmission Laterals

Gas transmission laterals connect the vertical collection wells to the main transmission headers leading to the North and South Flare stations. These laterals are connected to the well head with flexible fittings. The laterals are constructed of Schedule 40 PVC pipe and installed at ground level. All of the PVC pipe installed aboveground is painted to protect it from ultraviolet rays.

3.2.3 Connectors

Connectors are the fabricated connections of the gas transmission laterals to the main gas transmission lines. The connectors provide a location for controlling flow from individual wells and are used to monitor gas flows, gas quality, and pressure in the transmission lines.

3.2.4 Main Gas Transmission Headers

Main gas transmission headers were constructed to carry landfill gas from all wells to the North and South Flare stations. The headers are constructed of 6-to 10-inch Schedule 40 PVC pipe. The header pipe is constructed on the surface of the landfill except where it crosses the access roads next to the North and South Flare stations. At the road crossings, the gas header crosses under the roads. The road crossings are constructed of 10-inch HDPE pipe with an SDR rating of 26 and encased in a 15-inch corrugated steel pipe. The road crossings are shown in detail on Drawing 13 of the Phase 2 record drawings and Drawing 7 of the Phase 1 record drawings.

3.2.5 Condensate Sumps

Eighteen condensate sumps are installed at low points in the main gas header system. Condensate that collects in the header drains into the sumps where it is pneumatically pumped to 1,000-gallon condensate collection tanks located at the North and South Flare stations. The condensate sumps and the pumping system are shown in detail on Drawings 12 and 13 of the Phase 2 record drawings.

3.2.6 Flare Stations

Each flare station has four main components, a landfill gas scrubber, the blowers, a flare, and a motor control center. The scrubber cleans the gas of particulates and moisture before it enters the blowers. The blowers provide the vacuum necessary to extract gas from the landfill through the collection system. The flare ignites the gas prior to its emission into the atmosphere. The motor control center provides the automated electrical controls for the flare station operation including auto-shutdown capabilities in case of system failure.

3.3 Final Cover

The final cover system is designed to stop infiltration of surface water into the landfill, to provide positive drainage of the landfill surface, to prevent landfill gas venting, and to support vegetation. To do this, several layers of soil and geosynthetics were constructed over the refuse. Soils used for the construction of Phase 1 were obtained from an off-site source. The cover soils used for the 1991-92 Phase 2 closure were obtained from off-site and on-site borrow areas. The on-site borrow areas are located north and south of the landfill. Soils processed from on-site sources consisted of general earthfill, select earthfill, vegetative soil, topsoil, and rock for erosion protection. The following paragraphs describe the final cover components. The record drawings show the final cover components in relation to each other.

3.3.1 General Earthfill

The landfill surface conditions prior to construction consisted of a roughly graded soil surface with various amounts of exposed refuse. To prepare the landfill surface for final cover placement, the refuse was covered with soil and the landfill surface regraded.

General earthfill was placed over the landfill as needed to provide a firm foundation for other components of the final cover system and to construct positive drainage across the landfill. This material was placed in lifts not exceeding 1 foot in thickness and was compacted. The soil was placed to design subgrade elevations and then finish-graded.

During the 1992 portion of the Phase 2 construction, soil and burnt refuse were used for this purpose. The materials were obtained from an abandoned refuse burning area south of the landfill. This burn area is discussed in detail in the May 11, 1993, letter report to Ms. Rebecca Lawson of the Washington State Department of Ecology.

3.3.2 Select Earthfill

Select earthfill was placed over the general earthfill to provide a protective soil layer under the geomembrane. This material consists of screened soil with a maximum particle size of 1 inch. Gravel-sized materials in the select soil layer were rounded. The select earthfill was placed in a 6-inch-thick layer over the general earthfill and finish-graded with a steel drum roller. The select earthfill thickness was modified to 4 inches during the Phase 2 closure. The modification is discussed in Section 7 of this report.

3.3.3 Geomembrane

Geomembrane was placed directly over the select earthfill. The geomembrane product is a 60-mil-thick high density polyethylene sheet. Both textured and smooth product were installed. The product specifications are given on Tables 3-1 and 3-2. The geomembrane provides the impermeable element of the final cover system.

The geomembrane was installed and the seams welded using primarily the hot wedge welding process; however, the extrusion welding process was also used. The installation process consisted of deploying the sheeting by unrolling it and cutting panels to the required dimensions. The deployment was immediately followed by hot wedge welding of the seams. In areas where the hot wedge welder could not be used, the seam was welded using the extrusion welding technique. Figure 3-1 shows cross-sections of both seam welding techniques.

Following installation and seam welding, each weld was visually inspected and subjected to nondestructive and destructive testing. Nondestructive testing consisted of air-pressure testing of hot wedge welds or vacuum-box testing of extrusion welds. Destructive testing consisted of shear and peel tests on samples of the welded seams. The testing procedures and results are discussed in more detail in Section 6 of this report.

The orientation of geomembrane panels and destructive test locations are shown on the Panel Layout Drawings in Appendix B.

3.3.4 Drainage Layer

Drainage layer soil consisting of free-draining sand was placed directly over the HDPE geomembrane. Gradations and permeabilities are summarized in Appendix A.

The drainage layer was placed in a single 12-inch-thick lift over the entire geomembrane area. During placement and grading of the drainage layer, only low ground pressure dozers were allowed on the 12-inch-thick layer of drainage material. All other traffic on

Table 3-1

Smooth Geomembrane Properties

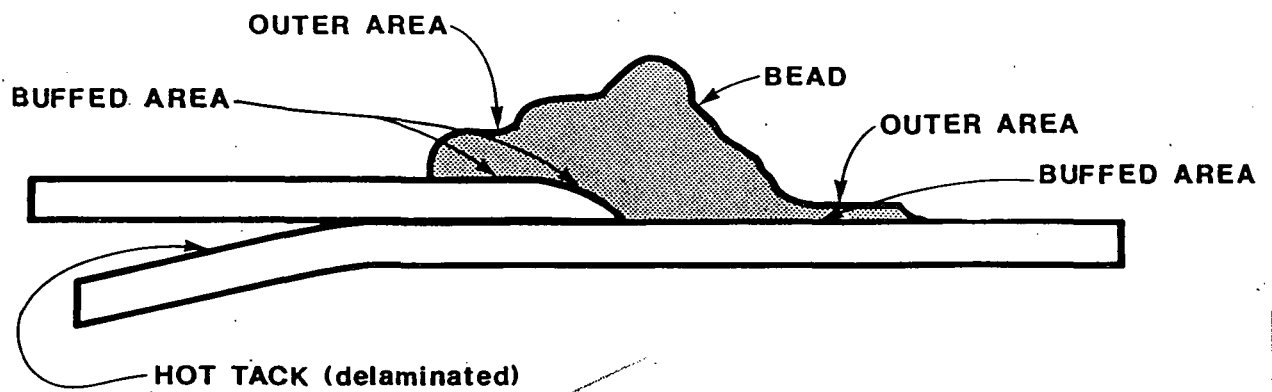
Test	Test Designation	Requirement
Sheet Thickness	ASTM D1593-81	60 mils $\pm 10\%$
Tensile Strength Yield	ASTM D638-84	Minimum 120 lbs per inch width
Tensile Strength at Break	ASTM D638-84	Minimum 225 lbs per inch width
Elongation at Yield	ASTM D638-84	Minimum 10%
Elongation at Break	ASTM D638-84	Minimum 500%
Modulus of Elasticity	ASTM D638-84	Minimum 80,000 lbs
Tear Resistance	ASTM D1004-81 Die C	Minimum 30 lbs
Puncture Resistance	FTMS 101B Method 2065	Minimum 75 lbs
Resistance to Soil Burial	ASTM D3083-76*	10% maximum change
Dimensional Stability (each direction)	ASTM D1204-84 212°F, 15 minutes	1.5% maximum change
Environmental Stress Crack	ASTM D1693-70*	2,000 hours
Low Temperature Brittleness	ASTM D746-79	Minus 40°F
Carbon Black Content	ASTM D1603-76	2% to 3%
Carbon Black Dispersion	ASTM D3015-85	A-2
Oxidation Induction Time	ASTM D3895	Min. 100 minutes

* As modified in National Sanitation Foundation - Standard Number 54, Appendix A, November 1983.

Table 3-2

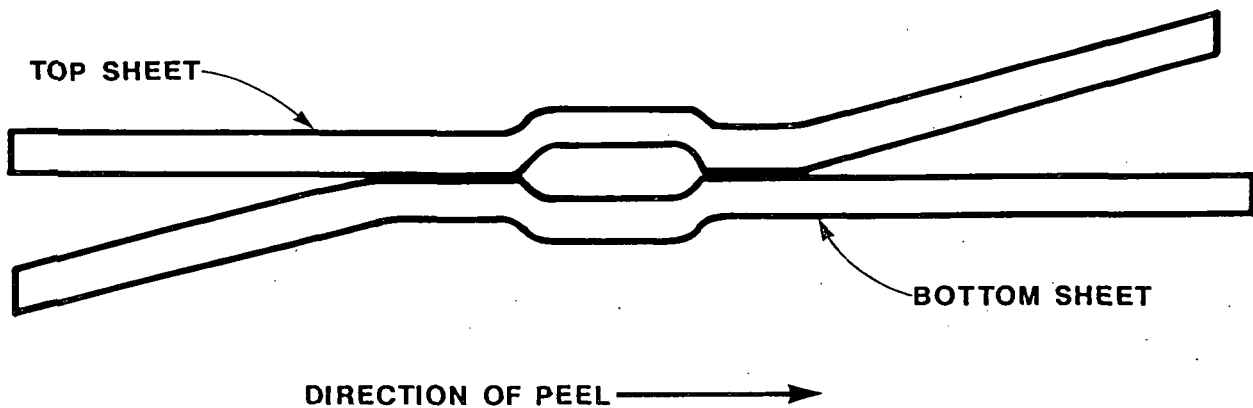
Textured Geomembrane Properties

Test	Test Designation	Requirement
Sheet Thickness	ASTM D1593-81	60 mils $\pm 10\%$
Tensile Strength Yield	ASTM D638-84	Minimum 126 lbs per inch width
Tensile Strength at Break	ASTM D638-84	Minimum 35 lbs per inch width
Elongation at Yield	ASTM D638-84	Minimum 13%
Elongation at Break	ASTM D638-84	Minimum 100%
Modulus of Elasticity	ASTM D638-84	Minimum 80,000 lbs
Tear Resistance	ASTM D1004-81 Die C	Minimum 30 lbs
Puncture Resistance	FTMS 101B Method 2065	Minimum 70 lbs
Resistance to Soil Burial	ASTM D3083-76*	10% maximum change
Dimensional Stability (each direction)	ASTM D1204-84 212°F, 15 minutes	2% maximum change
Environmental Stress Crack	ASTM D1693-70*	2,000 hours
Low Temperature Brittleness	ASTM D746-79	Minus 40°F
Carbon Black Content	ASTM D1603-76	2% to 3%
Carbon Black Dispersion	ASTM D3015-85	A-2
Oxidation Induction Time	ASTM D3895	Min. 100 minutes
* As modified in National Sanitation Foundation - Standard Number 54, Appendix A, November 1983.		



EXTRUSION WELD

FUSION WELD



Sweet-Edwards
EMCON

DATE _____
DWN. *gh*
APPR. *gh*
REVIS. _____
PROJECT NO.
0182-003.01

Figure 3-1
LEICHNER LANDFILL

GEOMEMBRANE WELD CROSS-SECTION

and off the drainage layer was over roads constructed from 3-foot-thick drainage layer materials or across landfill access roads. This was done to protect the geomembrane from equipment loading and possible damage.

The drainage layer collects and drains surface water which infiltrates the cover soil materials above it. This water drains through the sand along the surface of the geomembrane and is then collected by a system of 4-inch perforated polyethylene pipe under-drains. These pipes collect water from the drainage layer and transmit it to the surface water ditches. The location and detail of the under-drains are shown on the record drawings.

3.3.5 Nonwoven Geotextile

Nonwoven geotextile was placed over the drainage layer. The properties for this material are given on Table 3-3. The geotextile was deployed in much the same orientation as the geomembrane shown on the panel layout drawings. The geotextile was overlapped 6 inches, and the seams either were continuously sewn using polymeric thread or were heat bonded. The geotextile provides a filtering medium between the vegetative soil and the drainage layer. This protects the drainage layer from clogging by keeping fine vegetative soil particles out of the drainage layer.

3.3.6 Vegetative Soil

Vegetative soil was placed directly over the nonwoven geotextile. This soil was obtained from on-site and off-site sources. This material was placed using the same basic methods and equipment used for the drainage layer. It was placed in an 8-inch-thick layer.

The vegetative soil provides a rooting medium under the topsoil and a protective soil layer over the drainage layer and geotextile.

3.3.7 Topsoil

Topsoil provides a soil layer capable of supporting grassy vegetation. During Phase 1 construction and the 1991 portion of Phase 2 construction, topsoil was placed directly over the vegetative layer in two 4-inch-thick layers. This topsoil was imported from an off-site location. During the 1992 Phase 2 closure construction, topsoil was obtained from an on-site source. This modification is explained in detail in Section 7 of this report.

Soil analysis was performed on the topsoil to determine its ability to support the vegetation.

Table 3-3
Nonwoven Geotextile

Phase 1

Test	Test Designation	Requirement
Fabric Weight	ASTM D-3776	6 oz/yd ²
Grab Tensile Strength	ASTM D-4632	190 lbs
Grab Tensile Elongation	ASTM D-4632	> 50 %
Burst Strength	ASTM D-3786	295 psi
Permitivity	ASTM D-4491	0.1 cm/sec
Trapezoid Tear	ASTM D-3787	85 lbs
Puncture Resistance	ASTM D-3787	100 lbs
EOS		70 - 120

Phase 2

Test	Test Designation	Requirement
Grab Tensile Strength	ASTM D-4632	220 lbs
Puncture Resistance	ASTM D-3787	125 lbs
Permitivity	ASTM D-4491	1.5 sec -1

3.4 Access Roads

Landfill access roads were constructed as part of the closure. The alignment and elevations of the roads are shown on the record drawings. The roads were constructed to:

- Provide equipment and vehicle access to the proposed North Inert Fill
- Provide access to the gas well connectors and valves
- Provide access to the landfill cover for maintenance

During the closure construction, perimeter, maintenance, and facility access roads were constructed. The perimeter and maintenance roads were designed for light traffic and provided access to the landfill gas collection system and storm water facilities. The constructed road section included 12 inches of crushed road surfacing placed over a reinforcing geotextile. The facility access road was designed for heavy equipment traffic from the truck repair shop across the landfill to the proposed North Inert Fill. This road section includes geosynthetic reinforcement and 20 inches of crushed road surfacing. Both road types are shown in detail in the Phase 2 closure record drawings.

3.5 Surface Water Drainage and Control

Surface water drainage and control structures were constructed to minimize erosion, to prevent ponding of water on the landfill, to control the rate of discharge water, and to minimize off-site movement of waterborne soil particles. The following Phase 1 and Phase 2 construction components comprise the surface water drainage and control system.

- Surface water ditches
- Culverts
- Underdrains
- West Detention Basin and Pump Station
- Sedimentation Basin
- North Detention Basin and Pump Station
- Hydroseeding

3.5.1 Drainage Ditches

Phase 1 construction included Type 1 and Type 2 ditches. The Type 1 ditches are constructed on the landfill surface (see detail 2, drawing 3, Phase 1) and serve two purposes. The first is to collect surface water sheet-flowing off the landfill and convey it in a rock-lined ditch. The second is to collect water discharging from the drainage layer, convey it through an underdrain pipe, then discharge it to surface water ditches.

The Type 2 ditches are constructed around the perimeter of the Phase 1 closure area, just outside the limits of geosynthetics. They are grass-lined V-ditches graded into existing soil. They collect and convey surface water that is not collected in the Type 1 ditches. The ditches constructed during the Phase 1 closure construction are shown in detail in the Phase 1 record drawings.

Phase 2 construction included five ditch types. Types 1, 2, and 4 are perimeter ditches lined with geomembrane, geotextile, and rock. Types 1 and 2 are constructed adjacent and parallel to the perimeter road. The perimeter road provides vehicle access to the east, north, and west sides of the Phase 1 and 2 closure areas. The Type 1 ditch transitions into the Type 4 ditch, which then discharges into the west drainage basin. These ditches were designed to control surface water at the perimeter of the site and direct it to the west drainage basin.

The Type 3 ditch was constructed by placing a topsoil berm on the downslope side of the ditch flow line. The ditch was then lined with an erosion control matting and hydroseeded. The maximum slope on this ditch is 2 percent. It is designed to intercept sheet flow on the landfill surface and direct it either to the sedimentation basin or to the west drainage basin. A modified Type 3 ditch was also constructed. It is formed where the final cover meets the maintenance road embankment. The embankment forms the downslope portion of the ditch, and the ditch flow line is rock-lined.

The Type 5 ditch is lined with geomembrane, geotextile, and rock. It was constructed by excavating into the final cover topsoil and vegetative layer, placing the excavated soil as a berm on the downslope side of the ditch, then lining the ditch. It was designed for two purposes. The first was to intercept sheet flow on the landfill surface and direct it to the sedimentation basin. The second was to collect storm water discharging from the west drainage basin force main, then convey it to the sedimentation basin. Storm water that collects in the west drainage basin is pumped through a force main which discharges into the Type 5 ditch. Details of ditch Types 1, 2, 3, and 5 are shown on Drawing 7 of the Phase 2 record drawings. Details of ditch Type 4 are shown on Drawing 8.

3.5.2 Culverts

Culvert crossings were constructed to direct surface runoff under roadways. Two Type 3 ditches discharge into two 12-inch HDPE culverts, which direct surface water under the maintenance road. Eighteen-inch culverts are located at each end of the facility access road. They convey surface water under the facility access road, then discharge to the Type 4 ditch. One 12-inch HDPE culvert conveys surface water under the perimeter road adjacent to the north flare. This water flows to the drop inlet of the storm water collection system, then discharges into the North Sediment Basin.

3.5.3 Underdrains

The final cover system included a drainage layer placed on the geomembrane liner. Surface water that infiltrates the cover soils collects in the drainage layer. To drain this water out of the drainage layer, a series of underdrains were constructed. The underdrains are perforated polyethylene pipe. The pipes are placed in shallow troughs constructed in the geomembrane subgrade (see detail drawing). As the water moves across the geomembrane, it is trapped by the underdrain troughs, collects in the polyethylene pipe, and discharges into Type 1, 2, and 4 ditches. The underdrain pipes are generally spaced about 120 feet apart and inclined at approximately a 3 to 5 percent across the slope. The record drawings show underdrain locations and details.

3.5.4 West Detention Basin and Pump Station

The West Detention Basin was constructed to collect storm water runoff from the west side of the Phase 2 closure area and portions of the Leichner Brothers facilities area. The West Detention Basin is lined with Gundseal®, textured geomembrane, geotextile cushion, and a 1-foot layer of erosion protection rock. Drawing 17 of the Phase 2 record drawings shows the construction in detail.

The West Detention Basin includes a vault and pump station. The vault and pump station consist of a precast concrete vault, two submersible pumps, a PVC header and valving system, and an HDPE force main.

Storm water that collects in the west detention basin flows into the vault where it is then pumped through a HDPE force main that discharges into a Type 5 ditch. The ditch flows to the North Sediment Basin. Construction details of the vault and pump station are shown on Drawings 8 and 9 of the Phase 1 record drawings.

During the 1992 Phase 2 construction, modifications were made to the west detention vault, submersible pumps, and HPDE force main. These modifications are shown on Drawing 9 of the Phase 2 record drawings and described in Section 7 of this report.

3.5.5 North Sedimentation Basin

The storm water detention system was modified to include the North Sedimentation Basin. The North Sediment Basin was constructed during the 1992 Phase 2 closure construction and is described in detail in Section 7 of this report. The primary reason for its construction was to further control siltation in storm water discharged from the site. The basin is located at the east end of the North Detention Basin at the northeast corner of the Phase 1 closure area. The basin is lined with HDPE liner, and the liner is covered with 12 inches of sandy soil.

3.5.6 North Detention Basin and Pump Station

The North Detention Basin and the Pump Station consist of a geomembrane lined collection basin, a cast-in-place concrete outlet structure, and a pump station. Storm water enters the north detention basin via the North Sedimentation Basin. Storm water is then pumped through a ductile iron force main to the storm water outfall system which is described in Section 1.3, Related Work, of this report. The construction details of the North Detention Basin and Pump Station are shown on drawings 4, 5, and 6 of the Phase 1 record drawings.

3.5.7 Hydroseeding

Hydroseeding provides a grassy ground cover over the entire landfill surface and other surface areas disturbed by the construction. Hydroseeding mixes used for this project are shown on Table 3-4. The hydroseeding reduces erosion of the soil surfaces and provides an aesthetically pleasing appearance.

Seed mix A was changed for the 1992 Phase 2 closure. The changes are discussed in Section 7, Modifications During Construction.

Table 3-4

Hydroseed Mixes

MIX TYPE A

Seed Type Percent By Weight

Creeping Red Fescue	16.25%
Elka Perennial Ryegrass	81.83%
Other Crop	0.00%
Inert Matter	1.34%
Weed Seeds	0.18%
Noxious Weed Seeds	0.00%

MIX TYPE B

Seed Type Percent By Weight

Elka Perennial Ryegrass	50.00%
Barclay Perennial Ryegrass	10.00%
Cindy Creeping Red Fescue	20.00%
Cobra Creeping Bentgrass	
Mahonia Repens	2.5%
Cornus Stolonifera	2.5%

4 QUALITY ASSURANCE FUNCTION

4.1 General

The purpose of the construction quality assurance (CQA) program performed by EMCON is to document that the work performed by the Contractor was in compliance with the construction contract documents of August 1988 and May 1991. The contract documents are entitled "Leichner Brothers Landfill, Module 1B, 2 and 3 Closure," and "Leichner Brothers Landfill Phase 2 Closure." In addition to the contract documents, quality assurance manuals written by EMCON served as guidance documents for the quality assurance program.

The CQA program conducted by EMCON included surveys for as-built documentation. EMCON subcontracted this function to Olson Engineering Inc. The record survey information was used to produce much of the record as-built drawings.

4.2 Construction Monitoring

Construction monitoring included construction observation and materials testing. Construction observation was critical, especially for soil and geosynthetics materials, to establish confidence that the construction was executed uniformly. Materials testing was necessary to verify that the construction materials met specifications.

Guidelines for material testing frequencies used during the CQA program are presented in Table 4-1, Earthwork Construction Testing Frequencies, and in Table 4-2, Geosynthetics Construction Testing Frequencies.

The CQA program conducted by EMCON included geomembrane and geotextile conformance testing. EMCON subcontracted this function to laboratories specializing in this work. Summaries of geomembrane and geotextile conformance testing are included as part of this report (Appendix A).

Table 4-1

Earthwork Construction Testing Frequencies

Test	General Earthfill	Select Earthfill	Drainage Layer	Vegetative Layer	Topsoil	Aggregate Base
Nuclear Moisture Density	One Per ¹ 1,000 cy	One Per ¹ 2,000 cy	N/A	One Per ¹ 5,000 cy	N/A	One Per 250 cy
Sand Cone Moisture Density	One Per ¹ 20 Nuclear Tests	N/A	N/A	One Per ¹ 20 Nuclear Tests	N/A	N/A
Moisture Content	One Per 1,000 cy	N/A	N/A	One Per ¹ 5,000 cy	N/A	N/A
Grain Size Analysis	N/A	One Per 4,000 cy	One Per 3,000 cy	One Per 5,000 cy	N/A	One Per Source
Moisture Density Relationship D689	One Per ¹ 10,000 cy	One Per ¹ Source	N/A	as needed	N/A	One Per Source
Moisture Density Check Point D-689	as needed ¹	as needed ¹	N/A	as needed	as needed	as needed
Permeability	N/A	N/A	One Per 10,000 cy	2 Total	N/A	N/A
Chemical Analysis	N/A	N/A	N/A	N/A	One per source	N/A

¹ Phase 1 construction only.

Table 4-2

Geosynthetics Construction Testing Frequencies

Test	Frequency
Material Thickness	5/roll
Destructive Seam Testing	1/750 lineal feet
Nondestructive Seam Testing Fusion Seams	Continuous
Geomembrane Conformance Testing	1 per 100,000 square feet
Geotextile Conformance Testing	1 per 250,000 square feet

4.3 Field Engineering Services

Field engineering services were provided by the field representative and office engineering support. These services included clarifying questions from the Contractor, providing design interpretation, observing construction, providing design modifications when appropriate, and performing construction staking.

Engineering decisions which resulted in a design change or other deviation from the contract documents are either described in Section 7, Modifications During Construction, or are shown on the record drawings (Appendix C).

5 EARTHWORK QUALITY ASSURANCE

5.1 General

Earthwork construction quality assurance (CQA) included visual observation and testing to verify compliance with project specifications. Particular emphasis was placed on select earthfill and drainage layer placement.

In general, materials evaluation and testing activities included: (1) pre-construction testing; (2) visual evaluation of borrow area materials; (3) in-place density and moisture measurements; and (4) laboratory testing including moisture-density relationship tests, permeability tests from bulk samples, granular material sieve analyses, No. 200 sieve washes, and moisture content tests. CQA observation and testing for soil components of the project are discussed in the following paragraphs.

5.2 Documentation

Visual observations and tests were documented daily. Records of observations were kept primarily to document construction techniques in compliance with project specifications.

Test reports were kept for all field and laboratory testing. Each sample of material, obtained throughout the life of the project, was logged into the field soils laboratory. The sample log sheet was used to trace the sample number, the tests performed, and the party responsible for performing the tests. Field tests were recorded on daily test data sheets.

All laboratory and field test data have been summarized and are included in Appendix A of this report.

5.3 General Earthfill

General earthfill placement was observed and tested to document compliance with borrow sources, moisture conditioning, removal of oversized materials, lift thickness, compaction techniques, and grading. The compaction testing was limited to the Phase 1 construction. During Phase 2, acceptance of the contractor's work was based on placement techniques being similar to the successful work performed during Phase 1 work.

5.4 Select Earthfill

Observation of select earthfill placement was performed to document uniformity of the material and proper lift thickness. Laboratory tests were performed to verify that gradation requirements of the material were met.

5.5 Drainage Layer

Drainage layer observation was critical for two reasons: protection of the geomembrane underlying the drainage layer and visual observation of the soil gradation. Lift thicknesses and haul road thicknesses were monitored for compliance with specifications to assure protection of the geomembrane.

Permeability of the drainage layer is important in reducing saturation of the cover soil. Saturated conditions in the drainage layer do not impact cover stability or infiltration of surface water into refuse, but could impact access for maintenance during winter. Pre-construction testing was performed on each drainage layer source proposed for construction. In each case, pre-construction testing confirmed that the material was in accord with the specifications, so the sources were approved for construction. During construction, however, the material was again tested after it was placed on the geomembrane. In many cases the construction phase testing indicated fines contents (percent minus #200 sieve) to be higher than specified. Despite the high fines contents, permeability testing indicated acceptable results. Removing the out-of-spec drain layer after placement was ruled out. Removing this material could damage the geomembrane and not significantly improve the performance of the cover system.

5.6 Vegetative Soil

Observation of vegetative soil focused on material lift thickness, haul road thickness, and techniques for placing and grading of the material. Conformity to equipment and soil thickness was critical to protect geotextile placed under the vegetative soil. The vegetative layer was also monitored for presence of oversized cobbles. Oversized cobbles were identified by our CQA personnel and then removed by the Contractor. During Phase 1, field density tests were also performed to monitor percent compaction. This was done for informational purposes only. There was no critical compaction requirement.

5.7 Topsoil

Observation of topsoil placement included confirmation that the proper source was used, that processing was performed correctly, and that lift thickness was met. The thickness was controlled by the Contractor who set a series of elevation control stakes. EMCON

CQA personnel monitored thickness by periodically digging holes through the material and physically measuring the topsoil thickness. The quality of topsoil was also verified through testing. Chemical analysis was performed, and results of this testing are presented in Appendix A.

6 GEOSYNTHETICS QUALITY ASSURANCE

6.1 General

Two types of geomembrane were utilized for this project. Both were 60-mil high density polyethylene flexible membrane liner. One type of liner was smooth, and one was textured. The textured geomembrane was used on slopes steeper than 4H:1V. One was smooth and one was textured. Geotextile was installed over the drainage layer to provide a filter between topsoil and drainage layer soils.

The overall goal of the geosynthetics quality assurance program was to ensure that proper construction techniques and procedures were used and that they were in compliance with the project construction drawings and specifications. The geosynthetics CQA program included conformance testing of the geosynthetic products, construction phase testing of the installation, and observation of the work.

6.2 Geomembrane

The following geomembrane CQA monitoring and testing functions were performed:

- Monitored select earthfill placement for geomembrane subgrade
- Monitored panel deployment and maintained a panel layout record drawing
- Qualified extruder guns and hot wedge welders for daily welding with field start-up samples and tests
- Monitored tack and seam welds
- Monitored hot wedge welding
- Monitored welded seam vacuum testing
- Monitored welded seam air pressure testing

- Located defects in geomembrane and defective weld areas and recorded their repairs
- Located destructive weld samples and coordinated laboratory destructive weld testing
- Made on-site measurements such as material thickness, panel locations, planar areas, and ambient and material temperatures
- Coordinated geomembrane conformance testing

6.2.1 Destructive Testing for Welded Seams

Destructive testing of welded geomembrane seams included both on-site and off-site laboratory testing. At least one sample was taken for every 750 linear feet of welded geomembrane seam. The destructive test sample locations are shown on the panel layout record drawings (Appendix B). A total of 250 samples was taken. Each sample was approximately 44 inches long by 12 inches wide and was divided into three sections. One section was tested by the CQA team, one by the Contractor as part of the Contractor's quality control, and one was archived on site. The welded seam testing included shear and peel strengths of the welded seams.

If a destructive test failed, additional samples were cut and tested from the same seam 10 feet in each direction from the location of the failed test sample. If the additional test samples passed, then the entire seam between the test samples was capped and vacuum-tested. If the additional samples failed, then the process was repeated until passing tests were obtained, and the area between passing test samples was capped and vacuum-tested. The destructive test results are summarized in Appendix A (Table A-5).

In 1988, 1989, and 1992, both the Contractor and CQA organization destructively tested each sample. In 1991, the CQA organization tested about 15 percent of the samples and relied on the Contractor's quality control tests to verify the remaining seams. For tests listed in Table A-5 for 1991, the CQA tests are summarized in the comments column. All other test data for 1988, 1989, and 1992 are CQA test data.

6.2.2 Air Pressure Testing

The installer tested hot wedge welded seams by air pressure testing. The hot wedge technique creates an air channel between two welded seams. To pressure test the channel, access ports are cut at the ends of the welded seam. At one end, the installer seals the air channel by clamping the channel shut. The other end is also sealed, and an air pressure needle equipped with a pressure gauge is inserted. The pressure gauge has a valve for applying pressure through the needle into the air channel. The air channel

is pressurized to 30 psi for 5 minutes. Results are considered satisfactory when there is no more than a 2-psi drop in air pressure in 5 minutes. The 2-psi drop is attributed to expansion of the geomembrane material. CQA personnel observed and recorded the air pressure testing.

6.2.3 Vacuum-Testing

The Contractor vacuum-tested all extrusion-welded seams and seam repairs. The vacuum-testing equipment and operating techniques were monitored by the CQA personnel. Leaks detected by vacuum-testing were marked and recorded for repair. Documentation of vacuum-testing was recorded on daily seaming logs prepared by CQA personnel.


6.2.4 Panel Layout Drawings

Panel layout drawings were prepared as construction progressed. These drawings show the locations of each panel, seam, and destructive test. Panel layout drawings are presented in Appendix B. Panel placement logs indicating roll numbers and placement dates were prepared daily by CQA personnel.

6.3 Geotextile

Geotextile CQA included conformance testing of the product following its delivery to the site and observation of the installation.

Conformance testing was done to verify that material was manufactured in accord with the project specifications. The key requirement for this product was permeability. Samples were taken for every 250,000 square feet of product delivered to the site. Results of these tests are summarized in Appendix A.

 During the 1988 portion of Phase 1 work, some of the geotextile was installed prior to receiving conformance test results. When the results were received, strength values were below the specified values. However, the key requirement, permeability, was within acceptable values. Upon discovery of this problem, the remaining out-of-spec product was rejected, removed from the site, and replaced with new material which met specified requirements.

Observation of the installation was performed for two basic purposes. The first was to assure panel overlaps and seaming were performed in accord with the specifications. The second was to assure that the geotextile was not folded or damaged during the placement of vegetative soil and topsoil.

7 MODIFICATIONS DURING CONSTRUCTION

7.1 General

Several modifications were made during construction. Many of the modifications were made to fit the design to conditions encountered in the field. Others were made at the request of the Contractor after the Engineer reviewed their impact on the design intent; others were made by the Engineer to improve on the design and performance of the closure. This section describes those modifications. The record drawings show the as-built construction and reflect the modifications. The modifications are categorized as follows:

- Final cover
- Storm water management
- Landfill gas control
- Soil cover sources
- Miscellaneous modifications

7.2 Final Cover

The original Master Plan final cover design section had the following components. The components are listed from bottom to top as constructed:

- General earthfill
- Select earthfill
- Geomembrane
- Drainage layer
- Geotextile
- Vegetative soil
- Topsoil

During closure construction, minor modifications were made to each component except the drainage layer and geotextile. Descriptions of the modifications are given in the following paragraphs.

7.2.1 General Earthfill

During the 1992 Phase 2 closure, general earthfill was replaced with material excavated from the former burn waste area discovered south of the landfill. Excavation of these burn areas was required as part of the cleanup action plan (CAP). Material removed from these excavations was mostly soil, rock, ash, and glass, with minor amounts of metal.

The purpose of general earthfill was to fill in low spots on the refuse surface, regrade the surface to provide positive drainage, and provide a stable subgrade for constructing the final cover components. Since the burn area waste met the intent of general earthfill, it was used in place of general earthfill.

The volume of material excavated from the burn area exceeded the amount necessary to complete general earthfill placement, but the alternative to placing this material in the landfill was off-site disposal at extremely high cost. Therefore, the subgrade plan was modified slightly to allow higher grades. In general, subgrade elevations were raised approximately 3 feet to accommodate placement of the burn area waste. The volume of burn waste placed in the landfill was approximately 71,500 cubic yards.

7.2.2 Select Earthfill Modification

Select earthfill provides a protective bedding between the graded general earthfill and the geomembrane. The protective bedding prevents puncture of the geomembrane.

When the 1991 general earthfill placement and the 1992 burn area waste placement were complete, the resulting graded surface had very few irregular surfaces or protruding rocks. This surface was very near the quality specified for the completed select earthfill surface. Because of this quality surface, the thickness of select earthfill necessary to meet the design intent was reduced. During the Phase 2 closure, therefore the select earthfill depth was modified from 6 inches to 4 inches. This modification was also made to reduce project costs.

7.2.3 Geomembrane

The Master Plan cover design required installation of geonet and geotextile in conjunction with smooth geomembrane where slopes were 4H:1V (Horizontal:Vertical) or steeper. This design was intended to improve soil cover stability. This design was never incorporated into the Phase 1 or Phase 2 construction documents. Where slopes were greater the 4H:1V, the geonet/geotextile/smooth geomembrane design was replaced with textured geomembrane. Textured geomembrane provides the required cover stability when used in conjunction with the other cover soils. Textured geomembrane was installed on the slopes east of the West Detention Basin.

7.2.4 Vegetative Soil/Topsoil

During the 1992 portion of the Phase 2 closure, the vegetative soil and topsoil components were modified. The original design required placing 8 inches of vegetative soil over the geotextile. This was followed by 8 inches of topsoil placed over the vegetative soil with the first 4 inches mixed into the surface of the vegetative soil layer. During 1992, a single soil source meeting the requirements of both materials was obtained. Because it met requirements of both materials, it did not need to be placed in separate 8-inch lifts. The modification allowed the new source to be placed in a single 16-inch lift over the geotextile.

7.2.5 Expanded Final Cover Limits

The limits of final cover were expanded in four areas. The first was in the southwest corner of the Phase 2 closure area. The second and third were adjacent to the site property line west of the Phase 2 closure and south of the West Drainage Basin. The fourth was in the northwest corner of the North Detention Basin.

The first area, the southwest corner of the Phase 2 closure, was expanded over an old storm water infiltration basin. This basin, at times, received storm water that was mixed with runoff from exposed refuse. Since this storm water could have carried leachate-type contaminants, it was considered prudent to cover the area. In addition to the storm water concerns, monitoring well logs in this area showed that the drilling went through buried waste.

The second area is located between the perimeter road and the west property line in the Phase 2 closure. In this area, the geomembrane cover was expanded from the perimeter road down a slope to the property line. This expansion was done because drilling in this area provided some indication that refuse may extend up to the property line.

The third area is located south of the West Detention Basin. In this area, the cover was expanded south to the property line. This expansion was also done because of suspected waste burial in this area.

The fourth area is located at the northwest corner of the North Detention Basin. As with the second and third location mentioned above, there was evidence of buried waste in this area; therefore, the geomembrane liner was expanded to cover the area. Cover expansion areas, described as 1, 2, and 3 above, are shown on Drawing 2A of the Phase 2 record drawings. The limits of the cover described as area 4 are shown on Drawing 5 of the Phase 1 record drawings.

7.2.6 Topsoil Amendment

Analysis performed on topsoil imported to the site in 1991 indicated that a pH adjustment would be beneficial to the soil. The pH was adjusted by adding 1,363 pounds of dolomite limestone per acre of topsoil placed.

7.2.7 Modified Seed Mix

Hydroseed mix performance in the Phase 1 and 1991 portion of Phase 2 was fair, but it was felt that improvement could be made. During the 1992 Phase 2 closure, therefore, a new mix was used. The modified mix consisted of the following:

- Ten percent colonial bent grass
- Forty percent red fescue
- Forty percent perennial rye grass
- Ten percent white dutch clover "inoculated"

Performance of this seed mix has been very good.

7.3 Storm Water Management

The original Master Plan showed the limited storm water control features listed below:

- Surface water ditches
- West Detention Basin
- North Detention Basin
- Storm Water Outfall

Modifications made to these features as they relate to the Master Plan are described in a letter which updates the closure plan to reflect actual closure conditions. The storm water management modifications described in this report are limited to those changes made to construction documents issued for the Phase 1 and Phase 2 construction projects.

7.3.1 West Drainage Basin

During 1992 closure, the submersible pumps in the storm water vault were replaced with 10-horsepower pumps with 12-inch impellers. The new pumps have provided increased pumping capacity, and the 12-inch impeller have enabled pumping silt laden storm water without pump damage.

The original 6-inch-diameter HDPE force main which conveys storm water from the vault to its discharge point was modified before it was installed. The pipe diameter was

changed to 8 inches. The increased pipe capacity accommodates the new 10-horsepower pumps.

Storm water drop inlets were installed in the facilities area west of the landfill. Previously these drop inlets drained through storm sewers that entered the storm water vault. These inlets were modified upon completing the lining of the West Detention Basin. The storm sewer pipes were modified to drain directly into the West Detention Basin. The work included plugging the former inlets, then installing a new inlet that drains directly from the drainage basin. This modification was made to provide additional opportunity for siltation control of storm water leaving the facilities area. The drop inlets are shown on Drawing 8 in the Phase 1 record drawings. Modifications to the storm water vault inlets are shown on Drawings 9 and 17 of the Phase 2 record drawings.

7.3.2 Ditch Modifications

Ditch types 1, 2, and 4 required quarry spall rock lining. The quarry spalls were replaced with rock obtained from on-site soil processing. The processing is discussed later in this chapter.

7.3.3 Sedimentation Basin and Storm Sewerage System

As discussed in the Closure Plan amendment, a major addition was made to the storm water management system. This change was made under Change Order 2 to the Phase 2 closure contract. The change involved installation of a storm sewerage system and sedimentation basin.

The storm sewerage system collects surface water runoff from the northwest closure area and is designed to collect surface water from potential improvements north of the North Detention Basin. The storm sewerage system includes drop inlets, manholes, and HDPE pipe culverts which collect and convey storm water from the northwest closure area, around the detention basin, then into the sedimentation basin. Details of the system are shown on Phase 2 record drawings 19, 20, and 21.

The sedimentation basin was added to increase siltation control from surface water originating at the site. The basin is lined with 60-mil textured geomembrane. The geomembrane is covered with a geotextile cushion, and 12 inches of general soil fill covers the geotextile. Details of the sedimentation basin construction are shown on Phase 2 record drawings.

7.4 Landfill Gas Control System

The landfill gas control system includes the following major components:

- Gas extraction wells
- Collection piping
- Condensate sumps and holding tanks
- Gas blower/flare complex
- Gas monitoring probes

Modifications were made to each component.

7.4.1 Gas Extraction Wells

Two general modifications were made to the extraction wells 1992. The first was adding a bentonite seal around the vertical casing just below the geomembrane. This seal prevents landfill gas from venting around the vertical casing. The second modification was installing seven vertical gas extraction wells in Module 1B. The additional wells were necessary because wells installed in 1988 became saturated, partially plugged, and lost efficiency. The lost efficiency led to increased methane migration and high methane readings in perimeter gas monitoring probes. The installation of the additional wells corrected the landfill gas migration, and methane is no longer detected in the probes. The closure plan amendment discusses planned wells that will be added along the east side of the landfill in the summer of 1993.

7.4.2 Collection Piping

Collection system piping was routed differently than alignments shown on the construction drawings. Modifications were necessary to fit the piping system to final landfill contours and to maintain positive condensate control in the piping system. The record drawings show the as-built piping alignment.

7.4.3 Condensate Sumps

Three modifications were made to the condensate sumps.

First, the location of condensate sump number S-8 was modified near the west drainage basin due to grading changes made to construct the West Drainage Basin. Positive drainage from the piping system to the sump is necessary to collect condensate. The sump had to be relocated to meet this intent following the grading change.

Second, a bentonite seal was installed around the sumps just below the geomembrane. As with the vertical wells, this modification prevents gas venting through the final cover around the vertical sump casing.

Third, two gaskets were added at the tank adapter where the condensate line enters the sump. The two gaskets were installed and siliconed in place to prevent surface storm water from entering the sump at the tank adaptor connection.

7.4.4 Gas Blower/Flare Complex

One basic modification was made to the south gas blower/flare complex. The south complex was installed approximately 100 feet south of the originally planned location. The final landfill configuration and grades in the southwest corner of the landfill did not leave enough area to construct the complex. Lechner's purchase of property south of the landfill allowed the modified location. The as-built location of the flare complex is shown on the Phase 2 record drawings.

7.4.5 Gas Probes

Gas probes were not installed under the closure contracts. Modifications made to the gas probes are discussed in the Closure Plan Amendment.

7.5 Miscellaneous Modifications

Construction modifications were made that do not fit any of the four categories mentioned above. These modifications are summarized below.

7.5.1 Auto Sampler Wiring

Electrical wiring was installed to provide power supply to an auto sampler. The auto sampler automatically samples storm water at the North Detention Basin Pump Station.

7.5.2 Pulp Waste Removal

During the 1991 closure work, stockpiles of pulp waste were excavated and placed into the landfill. The pulp waste was located along the site property line west of the Phase 2 closure area. Removal of this waste allowed construction of the expanded cover and installation of perimeter fencing on the property line.

7.5.3 On-Site Borrow Areas

Two on-site borrow areas were developed to produce soil for final cover. The first borrow area was south of the landfill; the second was north of the North Detention Basin. The primary reason for using the two on-site borrow sources was cost savings. The use of these areas eliminated much of the need for soil importation and significantly reduced cost of the project.

The first borrow area was used to produce general earthfill, select earthfill, and vegetative soil. Select earthfill was generated by processing excavated soil through a 1-inch screen. A by-product of the processing was gravel and cobbles which ranged in sizes of 1 inch to 6 inches. This by-product was also used to replace quarry spalls where they were designed for erosion protection in the West Drainage Basin, Sedimentation Basin outlets, ditch lining, and other places directed by the Engineer during construction.

The second borrow area, located north of the site, was used to obtain vegetative soil and topsoil for the 1992 portion of the Phase 2 closure. As described earlier in this report, the soil obtained met requirements for vegetative soil and topsoil, and was, therefore, placed as a single 16-inch lift.

Another use of the south borrow area was backfilling the burn area waste excavations. Two burn areas were excavated. The volume of soil necessary to backfill the excavations was not quite generated by on-site borrow sources. Because of this, the excavation furthest to the west was not completely backfilled. Clark County has agreed to complete this backfill work by importing soil from County road projects.

7.5.4 Refuse Removal Sedimentation Basin

During construction of the Sedimentation Basin, refuse was encountered. This refuse was above the design base elevation of the basin and had to be removed to complete the work. Since the landfill cover was nearing completion, and no area was available within the original landfill footprint to dispose this refuse material, a location was needed for disposal. The former infiltration basin at the southwest corner of the landfill was chosen because refuse was discovered here, and the cover over the area was being expended.

8 CONCLUSIONS

EMCON performed the daily observation and testing described in this report. Because certain construction tasks proceed simultaneously, it was not possible to monitor each activity on a full-time basis. Based on the observations made, the tests performed, and design changes approved by the Owner and Engineer, EMCON believes the landfill closure described in this report was constructed in accordance with the design intent.

APPENDIX A

SUMMARY OF QUALITY ASSURANCE TESTING

Table A-1 Summary of Laboratory Soils Tests

Table A-2 Summary of Field Moisture/Density Tests

Table A-3 Summary of Geomembrane Conformance Test

Table A-4 Summary of Nonwoven Geotextile Conformance Tests

Table A-5 Summary of Destructive Tests on Geomembrane Seams

Table A-6 Summary of Hydraulic Conductivity Tests

Topsoil Laboratory Analyses

TABLE A-1
SUMMARY OF LABORATORY SOILS TESTS

TABLE NUMBER A-1
SUMMARY OF LABORATORY SOILS TESTS

PROJECT NAME: Leichter Closure Phase I and II
PROJECT NUMBER: 0182-001.10 & 0182-001.38
OWNER: Leichter Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: Nick Nickolas

SAMPLE NUMBER	SAMPLE DATE	PRODUCT	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	PERCENT PASSING #200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	REMARKS
102	11/8/88	General Earthfill							Moisture Check of Nuclear Gage 14.8 %
103	11/8/88	General Earthfill							Moisture Check of Nuclear Gage 15.2 %
104	11/8/88	General Earthfill							Moisture Check of Nuclear Gage 14.3 %
107	12/5/88	General Earthfill							Moisture Check of Nuclear Gage 15.4 %
108	12/5/88	General Earthfill							Moisture Check of Nuclear Gage 12.7 %
205	11/26/88	Select Earthfill	108	15.5					
208	12/5/88	Select Earthfill							Moisture Check of Nuclear Gage 18.4 %
210	12/5/88	Select Earthfill							Moisture Check of Nuclear Gage 18.8 %
211	12/5/88	Select Earthfill							Moisture Check of Nuclear Gage 18.5 %
300	10/27/88	Drainage Layer			2.8				Pre-construction sample submittal, K = 5.9 x 10 ⁻²
302	12/12/88	Drainage Layer			13.8				
303	12/13/88	Drainage Layer			8.3				
304	12/19/88	Drainage Layer			7.1				
307	12/28/88	Drainage Layer			7.5				
310	12/29/88	Drainage Layer	104.6	15.5					
311	12/30/88	Drainage Layer			6.4				
312	1/3/89	Drainage Layer			6.5				
313	1/3/89	Drainage Layer			1.8				
314	1/3/89	Drainage Layer							Moisture Check of Nuclear Gage 15.5 %
315	1/3/89	Drainage Layer	95.9	11.4					
316	1/11/89	Drainage Layer	111.1	15.9					
317	1/18/89	Drainage Layer			5.0				
318	1/18/89	Drainage Layer							Moisture Check of Nuclear Gage 13.8 %
319	1/23/89	Drainage Layer							Moisture Check of Nuclear Gage 14.2 %
320	1/24/89	Drainage Layer			5.9				
321	1/24/89	Drainage Layer			2.8				
322	1/24/89	Drainage Layer							Moisture Check of Nuclear Gage 11.2 %
323	1/26/89	Drainage Layer							Moisture Check of Nuclear Gage 12.6 %
324	1/27/89	Drainage Layer			3.8				
325	1/28/89	Drainage Layer							Moisture Check of Nuclear Gage 13.9 %
326	1/28/89	Drainage Layer			7.9				

TABLE NUMBER A-1
SUMMARY OF LABORATORY SOILS TESTS

PROJECT NAME: Leichter Closure Phase I and II
PROJECT NUMBER: 0182-001.10 & 0182-001.38
OWNER: Leichter Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: Nick Nickolas

327	2/13/89	Drainage Layer								Moisture Check of Nuclear Gage 15.0 %
328	2/13/89	Drainage Layer				3.6				
329	2/21/89	Drainage Layer								Moisture Check of Nuclear Gage 14.4 %
331	2/23/89	Drainage Layer				6.8				
332	2/23/89	Drainage Layer				6.8				
333	3/3/89	Drainage Layer								Moisture Check of Nuclear Gage 14.8 %
334	3/3/89	Drainage Layer				4.6				
339	7/20/89	Drainage Layer				3.0				
348	8/25/89	Drainage Layer				7.1				
349	8/27/89	Drainage Layer				6.6				
360	8/28/89	Drainage Layer				1.4				
361	8/28/89	Drainage Layer				2.0				
362	8/28/89	Drainage Layer				0.7				
401	1/5/89	Vegetative Soil								Sieve Analysis Met Specifications
402	1/5/89	Vegetative Soil								Moisture Check of Nuclear Gage 16.2 %
403	1/5/89	Vegetative Soil	100.7		15.9					100 % passing 3/8-inch sieve
404	1/5/89	Vegetative Soil								Moisture Check of Nuclear Gage 16.8 %
405	1/8/89	Vegetative Soil								Moisture Check of Nuclear Gage 16.7 %
406	1/8/89	Vegetative Soil								
407	1/8/89	Vegetative Soil	122.0		16.0					
408	1/7/89	Vegetative Soil								Moisture Check of Nuclear Gage 12.1 %
409	1/25/89	Vegetative Soil								Moisture Check of Nuclear Gage 12.7 %
411	1/30/89	Vegetative Soil								Moisture Check of Nuclear Gage 18.5 %
412	1/31/89	Vegetative Soil								Moisture Check of Nuclear Gage 15.1 %
413	3/7/89	Vegetative Soil								Moisture Check of Nuclear Gage 14.3 %
415	3/7/89	Vegetative Soil								Moisture Check of Nuclear Gage 17.5 %
601	7/6/89	Embankment for Basin	113.0		16.1					Sieve analysis met specifications
GI-001	7/22/91	General Earthfill	126.0		13.2					Moisture Check of Nuclear Gage 6.7 %
ND-001	7/24/91	General Earthfill								Moisture Check of Nuclear Gage 10.1 %
ND-002	7/24/91	General Earthfill								Moisture Check of Nuclear Gage 8.6 %
ND-003	7/24/91	General Earthfill								Moisture Check of Nuclear Gage 10.2 %
SF-001	7/28/91	Select Earthfill								Sieve analysis met specifications
DLR-002	7/24/91	Drainage Layer				2.8				Sieve analysis met specifications
PR-001	8/6/91	Drainage Layer				2.1				Sieve analysis met specifications

TABLE NUMBER A-1
SUMMARY OF LABORATORY SOILS TESTS

PROJECT NAME: Leichter Closure Phase I and II
PROJECT NUMBER: 0182-001.10 & 0182-001.38
OWNER: Leichter Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: Nick Nickolas

CR-001	8/6/91	Drainage Layer					2.0		Proposed Material, Sieve analysis met specs
CR-005	8/6/91	Drainage Layer					3.0		Sieve analysis met specifications
CR-006	8/8/91	Drainage Layer							Sieve analysis met specifications
CR-007	8/8/91	Drainage Layer							Sieve analysis met specifications
CR-008	8/8/91	Drainage Layer							Sieve analysis met specifications
CR-009	8/8/91	Drainage Layer							Sieve analysis met specifications
DLR-1	8/16/91	Drainage Layer					1.3		K = 7 x 10 -2
DLR-2	8/19/91	Drainage Layer					1.7		K = 9 x 10 -2
DLR-3	8/23/91	Drainage Layer					4.8		K = 4 x 10 -2
DLR-4	8/29/91	Drainage Layer					5.9		
DLR-5	8/10/91	Drainage Layer					6.3		
DLR-6	8/10/91	Drainage Layer					4.6		
SAR-01	6/2/92	Select Fill					6.4		
SAR-02	6/2/92	Select Fill					8.4		
FDL-2	6/5/92	Drainage Layer					3.3		
SDL-6	6/5/92	Drainage Layer					3.2		
SDL-05	6/8/92	Drainage Layer					6.6		
DLR-001	9/16/91	Drainage Layer					1.3		K = 1 x 10 -2
DLR-002	9/16/91	Drainage Layer					1.7		K = 1 x 10 -1
FDL-1	6/8/92	Drainage Layer					3.2		
FDLR-1a	6/15/92	Drainage Layer					2.1		
DLR-2b	6/16/92	Drainage Layer					3.5		
DLR-3b	6/16/92	Drainage Layer					3.1		
DLR-5a	6/17/92	Drainage Layer					3.2		
DLR-6b	6/18/92	Drainage Layer					3.2		
DLR-8b	6/19/92	Drainage Layer					2.9		
DLR-10a	6/22/92	Drainage Layer					2.6		
DLR-11b	7/15/92	Drainage Layer					3.6		K = 1 x 10 -1
DLR-12b	6/23/92	Drainage Layer					1.8		
DLR-13a	6/24/92	Drainage Layer					2.8		
DLR-14a	6/25/92	Drainage Layer					3.3		

TABLE NUMBER A-1 SUMMARY OF LABORATORY SOILS TESTS									
PROJECT NAME: Leichter Closure Phase I and II PROJECT NUMBER: 0182-001.10 & 0182-001.38 OWNER: Leichter Brothers Land Reclamation									
PREPARED BY: Mike Stewart CHECKED BY: Nick Nickoles									
DLR-18a	6/28/92	Drainage Layer					2.9		
DLR-18a	6/29/92	Drainage Layer					2.8		
DLR-18b	6/30/92	Drainage Layer					2.3		
DLR-20a	7/15/92	Drainage Layer					4.8		K = 1 x 10 -1
DLR-21a	7/11/92	Drainage Layer					2.4		
DLR-23b	7/12/92	Drainage Layer					2.5		
IPB-1	6/24/92	Topsoil					23.4		100 % passes the 3/8-inch sieve
IPB-2	6/25/92	Topsoil					18.0		100 % passes the 3/8-inch sieve
IPB-3	6/25/92	Topsoil					28.5		100 % passes the 3/8-inch sieve
IPB-4	6/24/92	Topsoil					33.6		100 % passes the 3/8-inch sieve
VTS-1a	7/14/92	Modified Topsoil					35.9		100 % passes the 3/8-inch sieve
VTS-2a	7/16/92	Modified Topsoil					41.8		100 % passes the 3/8-inch sieve
VTS-4a	7/21/92	Modified Topsoil					18.8		100 % passes the 3/8-inch sieve

TABLE A-2

SUMMARY OF FIELD MOISTURE/DENSITY TESTS

TABLE A-2

SUMMARY OF FIELD MOISTURE AND DENSITY TESTS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I
 PROJECT NUMBER: 012-001.10
 OWNER: Lechner Brothers Land Reclamation

PREPARED BY: N. Nickolas
 CHECKED BY: M. Stewart

TEST NUMBER	TEST DATE	PRODUCT	LOCATION EASTING	LOCATION NORTHING	REFERENCE CURVE DRY DENSITY (pcf)	REFERENCE CURVE OPT. MOIST. (%)	FIELD DRY DENSITY (pcf)	FIELD MOISTURE CONTENT (%)	SPECIFIED PERCENT COMPACTION	RELATIVE COMPACTION (%)	RELATIVE MOISTURE (%)
101	11-03-88	General fill	11670	12550	119.8	15.1	113.1	18.6	95	94.6	3.5
102	11-03-88	General fill	11670	12600	119.8	15.1	115.8	17.7	95	95.9	2.6
103	11-03-88	General fill	11630	12450	119.6	15.1	119.3	15.8	95	99.7	0.7
104	11-03-88	General fill	11660	12500	119.6	15.1	115.4	17.3	95	96.5	2.2
105	11-03-88	General fill	11670	12650	119.6	15.1	114.1	17.7	95	95.4	2.6
106	11-08-88	General fill	11700	13120	119.8	15.1	116.5	14.5	95	97.4	-0.6
107	11-08-88	General fill	11820	13120	119.8	15.1	121.2	13.7	95	101.3	-1.4
108	11-08-88	General fill	11830	13100	119.8	15.1	116.8	14.1	95	97.5	-1
109	11-08-88	General fill	11700	13430	119.8	15.1	124.8	11.5	95	104.4	-3.6
110	11-08-88	General fill	11830	13410	119.8	15.1	119	12.1	95	99.5	-3
111	11-08-88	General fill	11840	13450	119.8	15.1	116.8	14.5	95	97.7	-0.6
112	11-08-88	General fill	11770	13860	119.8	15.1	117.8	12.6	95	98.3	-2.5
113	11-08-88	General fill	11830	13880	119.8	15.1	116	14.4	95	95.2	-0.7
114	11-08-88	General fill	11850	13900	119.8	15.1	113.8	13.5	95	95.2	-1.6
115	12-06-88	General fill	11270	12870	119.6	15.1	118.5	11.2	95	99.1	-3.9
116	12-06-88	General fill	11270	12900	119.8	15.1	124.3	12.4	95	103.9	-2.7
117	12-06-88	General fill	11320	12880	119.8	15.1	117.4	13.1	95	98.2	-2
118	12-06-88	General fill	11320	12880	119.6	15.1	116.8	11	95	97.7	-4.1
119	12-06-88	General fill	11370	12870	119.6	15.1	117.8	14.7	95	98.5	-0.4
120	12-06-88	General fill	11370	12870	119.8	15.1	120.8	12.3	95	101.0	-2.8
121	12-06-88	General fill	13370	12870	119.8	15.1	123.9	10	95	103.6	-5.1
122	12-06-88	General fill	11440	12890	119.6	15.1	121.2	13.1	95	101.3	-2
123	12-06-88	General fill	11440	12890	119.6	15.1	119	11.2	95	99.5	-3.9
124	12-06-88	General fill	11440	12890	119.8	15.1	124.3	10.3	95	103.9	-4.8
125	12-06-88	General fill	11440	12890	119.8	15.1	113	8.4	95	94.5	-6.7
126	12-06-88	General fill	11510	12890	119.8	15.1	122.7	10.4	95	102.8	-4.7
127	12-06-88	General fill	11510	12890	119.8	15.1	119.8	10.8	95	100.2	-4.3
128	12-06-88	General fill	11510	12890	119.8	15.1	124.5	11.5	95	104.1	-3.6
129	12-06-88	General fill	11580	12900	119.8	15.1	122.1	11.4	95	102.1	-3.7
130	11-09-88	General fill	11580	12900	119.8	15.1	121.1	12.1	95	101.3	-3

TABLE A-2
SUMMARY OF FIELD MOISTURE AND DENSITY TESTS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I
PROJECT NUMBER: 012-001.10
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: N. Nickolas
CHECKED BY: M. Stewart

131	12-08-88	General fill	11660	12900	119.6	16.1	124	10.9	95	103.7	-4.2
132	12-08-88	General fill	11640	12880	119.6	16.1	122.2	13.2	95	102.2	-1.9
133	12-08-88	General fill	11740	12960	119.6	16.1	126.3	11.8	95	105.6	-3.3
134	12-08-88	General fill	11780	12970	119.6	16.1	125.6	12.1	95	104.9	-3
135	01-03-89	General fill	11700	14050	119.6	16.1	116.1	16.1	95	97.1	1
136	01-03-89	General fill	11850	14070	119.6	16.1	116.3	16.8	95	97.2	1.5
137	01-03-89	General fill	11980	14020	119.6	16.1	116.4	16.8	95	98.6	1.7
138	07-20-89	General fill	12040	13260	119.6	16.1	83.6	17.6	95	78.3	2.5
139	07-20-89	General fill	12070	13640	119.6	16.1	114.6	12.6	95	96.7	-2.5
140	07-20-89	General fill	12070	13910	119.6	16.1	116.4	10	95	97.3	-6.1
141	07-20-89	General fill	12060	13260	119.6	16.1	102.5	16.1	95	86.7	0
200	12-05-88	Select fill	11730	12850	108	16.5	108.8	17.2	95	100.8	1.7
201	12-05-88	Select fill	11640	12820	108	16.5	103.1	11.7	95	95.5	-3.8
202	12-05-88	Select fill	11350	12780	108	16.5	115	10.8	95	106.5	-4.7
203	12-05-88	Select fill	11300	12640	108	16.5	113.1	16.7	95	104.7	0.2
204	12-05-88	Select fill	11450	12950	108	16.5	110.8	19.7	95	102.6	4.2
205	12-05-88	Select fill	11650	12960	108	16.5	113.7	16.4	95	105.3	0.9
206	12-05-88	Select fill	11770	12960	108	16.5	112.9	11.4	95	104.5	-4.1
207	12-05-88	Select fill	11770	12460	108	16.5	107.4	17.6	95	98.4	2.1
208	12-05-88	Select fill	11610	12450	108	16.5	116.9	18.1	95	108.2	2.6
209	12-05-88	Select fill	11480	12440	108	16.5	113.3	16.8	95	104.8	0.3
210	12-05-88	Select fill	11310	12430	108	16.5	109	16	95	100.9	0.5
211	12-05-88	Select fill	11350	12260	108	16.5	107.7	9.2	95	98.7	-6.3
212	12-05-88	Select fill	11500	12280	108	16.5	108.2	9.2	95	100.2	-6.3
213	12-05-88	Select fill	11650	12290	108	16.5	108.7	10.5	95	100.6	-5
214	12-05-88	Select fill	11750	12330	108	16.5	114.3	10.4	95	105.8	-6.1
215	12-13-88	Select fill	11710	13820	108	16.5	112	16.4	95	103.7	0.9
216	12-13-88	Select fill	11800	13900	108	16.5	108	19.5	95	100.0	4
217	12-13-88	Select fill	11880	14030	108	16.5	111.5	18.3	95	103.2	2.8

TABLE A-2
SUMMARY OF FIELD MOISTURE AND DENSITY TESTS

PROJECT NAME: Leichter Brothers Landfill Closure, Phase I
PROJECT NUMBER: 012-001.10
OWNER: Leichter Brothers Land Reclamation

PREPARED BY: N. Nickolas
CHECKED BY: M. Stewart

218	12-13-88	Select fill	11650	13600	108	15.5	108.4	13.6	95	100.4	-1.9
219	12-13-88	Select fill	11750	13640	108	15.5	114	18.5	95	105.6	3
220	12-13-88	Select fill	11840	13690	108	15.5	112.7	15	95	104.4	-0.5
221	12-13-88	Select fill	11930	13730	108	15.5	123.7	12.4	95	114.5	-3.1
222	12-13-88	Select fill	11850	13400	108	15.5	120.1	13.3	95	111.2	-2.2
223	12-13-88	Select fill	11750	13400	108	15.5	120.3	13.6	95	111.4	-1.9
224	12-13-88	Select fill	11850	13400	108	15.5	116.5	12.5	95	107.9	-3
225	12-13-88	Select fill	11850	13400	108	15.5	117.3	11.4	95	108.6	-4.1
226	12-13-88	Select fill	11850	13150	108	15.5	115.2	11.9	95	106.7	-3.8
227	12-13-88	Select fill	11740	13190	108	15.5	114.3	13.7	95	105.8	-1.8
228	12-13-88	Select fill	11650	13230	108	15.5	117.2	11.5	95	108.5	-4
229	12-13-88	Select fill	11680	13020	108	15.5	107.6	9.7	95	99.6	-5.8
230	08-25-89	Select fill	11660	13040	108	15.5	112	12.9	95	103.7	-2.6
231	08-25-89	Select fill	11650	12890	108	15.5	109	11.8	95	100.9	-3.7
232	08-25-89	Select fill	11380	12885	108	15.5	104.4	10.4	95	96.7	-5.1
400	03-06-89	Vegetative layer	11650	13900	122	16	119.4	15.4	90	97.9	-0.6
401	03-06-89	Vegetative layer	11750	13900	122	16	123.3	11.1	90	101.1	-4.9
402	03-06-89	Vegetative layer	11850	13900	122	16	117.6	12.2	90	98.4	-3.8
403	03-06-89	Vegetative layer	11950	13900	122	16	117.8	9.1	90	96.8	-6.9
404	03-06-89	Vegetative layer	11650	13510	122	16	121.6	12.3	90	99.7	-3.7
405	03-06-89	Vegetative layer	11750	13510	122	16	121.2	13	90	99.3	-3
406	03-06-89	Vegetative layer	11850	13510	122	16	121.4	12	90	99.5	-4
407	03-06-89	Vegetative layer	11850	13510	122	16	117.8	12.3	90	96.8	-3.7
408	03-06-89	Vegetative layer	11850	13710	122	16	110.1	16.6	90	90.2	0.6
409	03-06-89	Vegetative layer	11750	13710	122	16	117.4	12.7	90	96.2	-3.3
410	03-06-89	Vegetative layer	11850	13710	122	16	109.8	15.6	90	90.0	-0.4
411	03-06-89	Vegetative layer	11930	13710	122	16	116.9	10.8	90	95.8	-5.4

TABLE A-3

SUMMARY OF GEOMEMBRANE CONFORMANCE TESTS

TABLE A-3
SUMMARY OF GEOMEMBRANE CONFORMANCE TESTS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I
Project Number: 0182-001.10
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: R.Roberts
CHECKED BY: N.Nickolas
MANUFACTURER: Poly-America
PRODUCT: 60-mil Smooth HDPE Geomembrane

CONFORMANCE		THICKNESS	CARBON BLACK CONTENT	CARBON BLACK DISPERSION	SPECIFIC GRAVITY	TENSILE AT BREAK	TENSILE AT YIELD	ELONGATION AT BREAK	ELONGATION AT YIELD	TEAR RESISTANCE	PUNCTURE RESISTANCE
TEST	TEST	ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	FTMS-101B
DESIGNATION	DESIGNATION	D-1593	D-1603	D-3015	D792	D-638	D-638	D-638	D-638	D-1004, DIE C	METHOD 2065
SPECIFIED VALUE	60.58 AVG. (MILS)	2.0-3.0 (%)	A-1, A-2, B-1	>0.934 (G/CC)	225 (PPI)	120lb. (MIN)	300 (%)	10% (MIN)	30 lb. (MIN)	75 lb. (MIN)	(LBS)
SAMPLE NUMBER	ROLL NUMBER	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS
P692-1	0492-4	2.28	A-1	0.945	289/267		830/790				
P692-2	14059	2.23	A-1	0.944	273/268		820/830				
P692-3	15150	2.34	A-1	0.944	299/294		830/800				
P692-4	14025	2.43	B-2	0.945	303/312		830/830				
P692-5	17112	2.54	A-1	0.947	352/281		750/810				
P692-6	15105	2.17	A-1	0.947	265/288		790/810				
P692-7	17082	2.75	A-1	0.946	269/286		770/830				
P692-8	15137	2.12	A-1	0.947	251/279		770/840				
P692-9	15400	2.7	A-1	0.946	262/275		770/790				
P692-10	0111-4	62	A-1	0.939	271/293	159/171	816/874	16.3/14.1	61/59	97	
P692-11	954-4	63.2	A-1	0.951	291/298	171/165	927/882	15.2/16.6	57/66	102	
P692-12	1004-1	58.4	A-1	0.94	278/270	144/147	903/924	16.7/16.1	56/54	92	

TABLE A-3

SUMMARY OF GEOMEMBRANE CONFORMANCE TESTS

PROJECT NAME: Lechner Brothers Phase II Closure
 Project Number: 0182-001.38
 OWNER: Lechner Brothers Land Reclamation

PREPARED BY: R.Roberts
 CHECKED BY: N.Nickolas
 MANUFACTURER: Gundie Lining Inc.
 PRODUCT: 60-mil Smooth HDPE Geomembrane

CONFORMANCE TEST	THICKNESS	CARBON BLACK CONTENT	CARBON BLACK DISPERSION	SPECIFIC GRAVITY	TENSILE AT BREAK	TENSILE AT YIELD	ELONGATION AT BREAK	ELONGATION AT YIELD	TEAR RESISTANCE
TEST DESIGNATION	ASTM D-1593	ASTM D-1603	ASTM D-3015	ASTM D792	ASTM D-638	ASTM D-638	ASTM D-638	ASTM D-638	ASTM D-1004, DIE C
SPECIFIED VALUE	60.58 AVG. MIL (MILS)	2.0-3.0 (%)	A-1 A-2 B-1	>0.934 (G/CC)	225 (PPI)	(PPI)	300 % (MIN.)	(MIN.)	(LBS)
SAMPLE NUMBER	ROLL NUMBER	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS Mach/Trans	TEST RESULTS	TEST RESULTS Mach/Trans		TEST RESULTS
CT-1	4010	66.9	A-1	0.946	291/315		883/868		
CT-2	7770	65	A-1	0.945	286/308		821/848		
HCT-03	11502	64.1	A-1	0.947	293/302		821/848		
HCT-04	10366	60.9	A-1	0.949	231/309		785/861		
HCT-05	11535	62.6	A-1	0.949	311/333		907/972		
HCT-06	11511	60.6	A-1	0.95	261/287		804/858		
HCT-07		61.4	A-1	0.947	278/283		867/928		
HCT-08		61.4	A-1	0.947	293/315		836/922		
HCT-09		61.5	A-1	0.947	280/271		859/894		
CT-11	11592	62.3	A-1	0.949	287/305		816/927		
CT-01	17091	63.1	A-1	0.949	306/317		654/694		
CT-02	14059	61.2	A-1	0.947	278/289		613/644		
CT-03	15150	59	A-1	0.946	265/306		596/708		
CT-04	14025	61.8	A-1	0.947	299/300		688/702		
CT-05	17112	62.6	A-1	0.947	292/320		643/699		
CT-06	15105	60.6	A-1	0.947	287/313		627/704		
CT-07	17082	61.8	A-1	0.946	274/294		622/682		
CT-08	15137	61.3	A-1	0.951	295/304		649/697		

TABLE A-4

**SUMMARY OF NONWOVEN GEOTEXTILE
CONFORMANCE TESTS**

TABLE NUMBER A-4

PREPARED BY: R. Roberts
CHECKED BY: N. Nickoles
MANUFACTURER: Quiline
PRODUCT: Nonwoven Geo

[illegible]

TABLE A-5

**SUMMARY OF DESTRUCTIVE TESTS
ON GEOMEMBRANE SEAMS**

TABLE NUMBER A-5
SUMMARY OF DESTRUCTIVE TESTS ON WELDED GEOMEMBRANE SEAMS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I and Phase II
PROJECT NUMBER: 0182-001.10 and 0182.001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: R. Roberts
INSTALLER: Gagle 88,89 and Serrot 81,82
PRODUCT: 60 Mil Smooth and Textured HDPE

TEST			AVERAGE PEEL, SIDE 1	BREAK TYPE SIDE 1	AVERAGE PEEL, SIDE 2	BREAK TYPE SIDE 2	AVERAGE SHEAR	BREAK TYPE	
TEST DESIGNATION			ASTM D-413	ASTM D-413	ASTM D-413	ASTM D-413	ASTM D-3083	ASTM D-3083	
SPECIFIED VALUE			84 (PPH)	FTB	84 (PPH)	FTB	108 (PPH)	FTB	
SAMPLE NUMBER	WELD DATE	LOCATION (SEAM #)	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	
DS-01	12/14/88	102-103	126	FTB			163	FTB	
DS-02	12/14/88	103-104	118	FTB			158	FTB	
DS-03	12/16/88	104-105	110	FTB			154	FTB	
DS-04	12/16/88	105-106	106	FTB			147	FTB	
DS-05	12/16/88	106-107	122	FTB			148	FTB	
DS-06	12/16/88	107-108	128	FTB			152	FTB	
DS-07	12/16/88	108-109	122	FTB			146	FTB	
DS-08	12/16/88	109-110	114	FTB			152	FTB	
DS-09	12/17/88	110-111	123	FTB			138	FTB	
DS-10	12/17/88	112-113	115	FTB			146	FTB	
DS-11	12/17/88	113-114	115	FTB			147	FTB	
DS-12	12/17/88	114-115	121	FTB			148	FTB	
DS-13	12/17/88	115-116	122	FTB			162	FTB	
DS-14	12/28/88	117-118	125	FTB			169	FTB	
DS-15	12/28/88	118-119	125	FTB			161	FTB	
DS-16	12/28/88	119-120	121	FTB			162	FTB	
DS-17	12/28/88	120-121	118	FTB			165	FTB	
DS-18	12/28/88	121-122	128	FTB			162	FTB	
DS-19	12/28/88	123-124	128	FTB			161	FTB	
DS-20	12/28/88	124-125	125	FTB			158	FTB	
DS-21	12/28/88	125-126	117	FTB			138	FTB	
DS-22	1/12/89	128-129	118	FTB			154	FTB	
DS-23	1/12/89	129-130	112	FTB			147	FTB	
DS-24	1/18/89	101-132	FAIL	FTB			FAIL	FTB	Adhesion failure
DS-24A	1/18/89	101-132	120	FTB			163	FTB	Re-test seam # 101-132
DS-25	1/18/89	101-133	135	FTB			164	FTB	
DS-26	1/18/89	133-134	130	FTB			169	FTB	
DS-27	1/18/89	134-135	139	FTB			160	FTB	
DS-28	1/30/89	135-136	127	FTB			158	FTB	
DS-29	1/30/89	136-137	126	FTB			153	FTB	
DS-30	1/23/89	138-139	120	FTB			158	FTB	
DS-31	1/23/89	139-140	130	FTB			165	FTB	
DS-32	1/23/89	140-141	131	FTB			170	FTB	
DS-33	1/23/89	141-142	120	FTB			143	FTB	
DS-34	1/24/89	142-143	125	FTB			151	FTB	
DS-35	1/24/89	144-145	131	FTB			160	FTB	
DS-36	1/24/89	145-146	121	FTB			157	FTB	
DS-37	1/25/89	147-148	138	FTB			161	FTB	
DS-38	1/28/89	201-202	118	FTB			151	FTB	

TABLE NUMBER A-5
SUMMARY OF DESTRUCTIVE TESTS ON WELDED GEOMEMBRANE SEAMS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I and Phase II
PROJECT NUMBER: 0182-001.10 and 0182.001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: R. Roberts
INSTALLER: Gagle 88,89 and Serrot 91,92
PRODUCT: 60 Mil Smooth and Textured HDPE

TEST			AVERAGE PEEL, SIDE 1	BREAK TYPE SIDE 1	AVERAGE PEEL, SIDE 2	BREAK TYPE SIDE 2	AVERAGE SHEAR	BREAK TYPE	
TEST			ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	
DESIGNATION			D-413	D-413	D-413	D-413	D-3083	D-3083	
SPECIFIED VALUE			84 (PPI)	FTB	84 (PPI)	FTB	108 (PPI)	FTB	
SAMPLE NUMBER	WELD DATE	LOCATION (SEAM #)	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	COMMENTS
DS-38	1/28/89	202-203	128	FTB			184	FTB	
DS-40	1/28/89	203-204	180	FTB			156	FTB	
DS-41	1/28/89	204-205	124	FTB			161	FTB	
DS-42	1/28/89	205-206	128	FTB			156	FTB	
DS-43	1/29/89	207-208	133	FTB			184	FTB	
DS-44	1/29/89	208-209	128	FTB			167	FTB	
DS-45	1/29/89	209-210	132	FTB			155	FTB	
DS-46	1/30/89	205a-206a	122	FTB			153	FTB	
DS-47	1/30/89	208a-209a	137	FTB			182	FTB	
DS-48	2/13/89	212-213	117	FTB			162	FTB	
DS-49	2/13/89	213-214	125	FTB			159	FTB	
DS-50	2/13/89	214-215	123	FTB			157	FTB	
DS-51	2/13/89	215-216	117	FAIL			153	FAIL	Adhesion Failure
DS-51A	2/21/89	215-216	117	FTB			159	FTB	Re-test DS-51
DS-52	2/13/89	218-217	122	FTB			158	FTB	
DS-53	2/13/89	217-218	118	FTB			153	FTB	
DS-54	2/13/89	218-219	135	FTB			157	FTB	
DS-55	2/13/89	219-220	113	FTB			156	FTB	
DS-56	2/13/89	220-221	124	FTB			150	FTB	
DS-57	2/14/89	213a-214a	114	FTB			151	FTB	
DS-58	2/14/89	216a-217a	120	FTB			166	FTB	
DS-59	2/15/89	218a-219a	126	FTB			189	FTB	
DS-60	2/15/89	220a-221a	127	FTB			167	FTB	
DS-61	2/15/89	223a-224a	122	FTB			155	FTB	
DS-62	2/26/89	223-224	122	FTB			173	FTB	
DS-63	2/26/89	227-228	122	FTB			156	FTB	
DS-64	2/26/89	230-231	133	FTB			169	FTB	
DS-65	2/26/89	233-234	122	FTB			182	FTB	
DS-66	2/26/89	236-237	118	FTB			156	FTB	
DS-67	2/26/89	239-240	120	FTB			164	FTB	
DS-68	2/26/89	242-243	128	FTB			163	FTB	
DS-69	2/26/89	245-246	110	FTB			155	FTB	
ARDS-70	8/11/89	5	110	FTB			198	FTB	
ARDS-71	8/11/89	7	123	FTB			192	FTB	
ARDS-72	8/11/89	10	109	FTB			182	FTB	
ARDS-73	8/15/89	14	125	FTB			187	FTB	
ARDS-74	8/16/89	18	115	FTB			181	FTB	
DBDS-01	7/28/89	4	133	FTB			198	FTB	
DBDS-02	7/31/89	8a	127	FTB			185	FTB	
DBDS-03	8/1/89	13	128	FTB			171	FTB	
DBDS-04	8/5/89	18	110	FTB			180	FTB	
DBDS-05	8/5/89	21	131	FTB			190	FTB	
DBDS-06	8/5/89	29	139	FTB			198	FTB	
DBDS-07	8/5/89	34	138	FTB			193	FTB	

TABLE NUMBER A-6
SUMMARY OF DESTRUCTIVE TESTS ON WELDED GEOMEMBRANE SEAMS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I and Phase II
PROJECT NUMBER: 0182-001.10 and 0182.001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: R. Roberts
INSTALLER: Gagle 88,89 and Serrot 91,92
PRODUCT: 60 Mil Smooth and Textured HDPE

TEST			AVERAGE PEEL, SIDE 1	BREAK TYPE SIDE 1	AVERAGE PEEL, SIDE 2	BREAK TYPE SIDE 2	AVERAGE SHEAR	BREAK TYPE	COMMENTS
TEST			ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	
DESIGNATION			D-413	D-413	D-413	D-413	D-3083	D-3083	
SPECIFIED VALUE			84 (PPF)	FTB	84 (PPF)	FTB	108 (PPF)	FTB	
SAMPLE NUMBER	WELD DATE	LOCATION (SEAM #)	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	
DBDS-08	8/7/89	38	121	FTB			180	FTB	
DBDS-09	8/7/89	41	132	FTB			183	FTB	
DBDS-10	8/10/89	48	111	FTB			187	FTB	
DBDS-11	8/10/89	52	115	FTB			154	FTB	
DBDS-12	8/10/89	53	121	FTB			189	FTB	
DBDS-13	8/10/89	64	128	FTB			183	FTB	
DBDS-14	8/10/89	66	109	FTB			189	FTB	
DBDS-15	8/10/89	67	112	FTB			191	FTB	
DBDS-16	8/10/89	68	111	FTB			189	FTB	
DBDS-17	8/16/89	81	132	FTB			186	FTB	
DBDS-18	8/16/89	83	138	FTB			183	FTB	
DBDS-19	8/16/89	88	134	FTB			179	FTB	
DBDS-20	8/17/89	91	128	FTB			188	FTB	
DBDS-21	8/17/89	92	137	FTB			189	FTB	
DBDS-22	8/17/89	94	129	FTB			184	FTB	
DBDS-23	8/18/89	98	125	FTB			177	FTB	
DBDS-24	8/18/89	101	134	FTB			173	FTB	
DS-01	8/18/89	1	118	FTB			183	FTB	
DS-02	8/18/89	2	119	FTB			174	FTB	
DS-03	8/18/89	3	99	FTB			187	FTB	
DS-04	8/18/89	4	131	FTB			174	FTB	
DS-05	8/18/89	6	134	FTB			170	FTB	
DS-06	8/24/89	7	124	FTB			188	FTB	
DS-07	8/24/89	8	111	FTB			181	FTB	
DS-08	8/24/89	9	118	FTB			187	FTB	
DS-09	8/24/89	11	127	FTB			189	FTB	
DS-10	8/24/89	12	129	FTB			188	FTB	
DS-11	8/24/89	13	121	FTB			188	FTB	
DS-12	8/24/89	14	125	FTB			190	FTB	
DS-13	8/25/89	16	131	FTB			188	FTB	
DS-14	8/25/89	17	138	FTB			198	FTB	
DS-15	8/25/89	18	149	FTB			194	FTB	
DS-16	8/25/89	19	133	FTB			185	FTB	
DS-17	8/26/89	22	129	FTB			184	FTB	
DS-18	8/26/89	23	148	FTB			187	FTB	
DS-19	8/26/89	24	142	FTB			165	FTB	
DS-20	8/28/89	25	148	FTB			174	FTB	
DS-21	8/28/89	27	147	FTB			167	FTB	
DS-22	8/29/89	28	148	FTB			188	FTB	
DS-23	8/29/89	29	125	FTB			170	FTB	
DS-24	8/29/89	30	140	FTB			170	FTB	
DS-25	8/29/89	35	114	FTB			181	FTB	
DS-26	8/29/89	40	113	FTB			182	FTB	
DS-27	8/29/89	45	110	FTB			188	FTB	

TABLE NUMBER A-5
SUMMARY OF DESTRUCTIVE TESTS ON WELDED GEOMEMBRANE SEAMS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I and Phase II
PROJECT NUMBER: 0182-001.10 and 0182.001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: R. Roberts
INSTALLER: Gagle 88,89 and Serrot 91,92
PRODUCT: 60 Mil Smooth and Textured HDPE

TEST			AVERAGE PEEL, SIDE 1	BREAK TYPE SIDE 1	AVERAGE PEEL, SIDE 2	BREAK TYPE SIDE 2	AVERAGE SHEAR	BREAK TYPE	COMMENTS
TEST DESIGNATION			ASTM D-413	ASTM D-413	ASTM D-413	ASTM D-413	ASTM D-3083	ASTM D-3083	
SPECIFIED VALUE			84 (PPH)	FTB	84 (PPH)	FTB	108 (PPH)	FTB	
SAMPLE NUMBER	WELD DATE	LOCATION (SEAM #)	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	
DS-28	8/30/89	54	115	FTB			165	FTB	
DS-29	8/30/89	60	121	FTB			164	FTB	
DS-30	8/30/89	59	127	FTB			171	FTB	
DS-31	8/30/89	58	121	FTB			168	FTB	
DS-32	8/30/89	61	118	FTB			170	FTB	
DS-01	8/8/91	1-2	111	FTB			178	FTB	Third party peel 107, shear 161
DS-02	8/8/91	1-2	110	FTB			164	FTB	
DS-03	8/8/91	2-3	103	FTB			168	FTB	Third party peel 100, shear 148
DS-04	8/8/91	3-48	110	FTB			171	FTB	
DS-05	8/8/91	4-5	108	FTB			181	FTB	
DS-06	8/17/91	5-19	115	FTB			157	FTB	Third party peel 117, shear 147
DS-07	8/10/91	8-9	137	FTB			184	FTB	Third party peel 126, shear 165
DS-08	8/10/91	9-10	117	FTB			174	FTB	
DS-09	8/10/91	11-12	119	FTB			178	FTB	
DS-10	8/11/91	26-27	98	FTB			176	FTB	
DS-11	8/11/91	13-14	135	FTB			171	FTB	
DS-12	8/11/91	14-29	93	FTB			178	FTB	
DS-13	8/11/91	30-31	117	FTB			178	FTB	
DS-14	8/11/91	31-32	98	FTB			185	FTB	
DS-15	8/11/91	32-33	118	FTB			171	FTB	
DS-16	8/11/91	34-35	118	FTB			178	FTB	
DS-17	8/12/91	35-38	138	FTB			185	FTB	
DS-18	8/12/91	37-38	120	FTB			168	FTB	
DS-19	8/12/91	38-35	124	FTB			170	FTB	
DS-20	8/12/91	40-41	83	FTB			168	FTB	Third party peel 108, shear 151
DS-21	8/12/91	41-42	97	NFTB FAIL			167	FTB	Repaired and re-tested, see DS-61
DS-22	8/12/91	43-44	98	NFTB FAIL			176	FTB	Repaired and re-tested, see DS-47
DS-23	8/12/91	44-45	115	FTB			180	FTB	
DS-24	8/13/91	46-47	118	FTB			177	FTB	
DS-25	8/13/91	47-48	114	FTB			185	FTB	
DS-26	8/13/91	49-50	138	FTB			187	FTB	
DS-27	8/13/91	50-51	118	FTB			174	FTB	
DS-28	8/13/91	52-53	122	FTB			169	FTB	
DS-29	8/13/91	53-54	115	FTB			177	FTB	
DS-30	8/13/91	55-56	118	FTB			219	FTB	Third party peel 125, shear 160
DS-31	8/13/91	56-57	117	FTB			178	FTB	
DS-32	8/13/91	58-59	123	FTB			173	FTB	
DS-33	8/13/91	46-79	141	FTB			171	FTB	
DS-34	8/13/91	83-84	111	FTB			108	FTB	
DS-35	8/13/91	84-85	107	FTB			173	FTB	
DS-36	8/13/91	84-95	109	FTB			172	FTB	
DS-37	8/13/91	95-98	117	FTB			178	FTB	
DS-38	8/13/91	98-97	110	FTB			174	FTB	
DS-39	8/16/91	98-99	110	FTB			179	FTB	

TABLE NUMBER A-5
SUMMARY OF DESTRUCTIVE TESTS ON WELDED GEOMEMBRANE SEAMS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I and Phase II
PROJECT NUMBER: 0182-001.10 and 0182.001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: R. Roberts
INSTALLER: Gagle 88,89 and Serrot 91,92
PRODUCT: 60 Mil Smooth and Textured HDPE

TEST			AVERAGE PEEL, SIDE 1	BREAK TYPE SIDE 1	AVERAGE PEEL, SIDE 2	BREAK TYPE SIDE 2	AVERAGE SHEAR	BREAK TYPE	
TEST			ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	
DESIGNATION			D-413	D-413	D-413	D-413	D-3083	D-3083	
SPECIFIED VALUE			84 (PSI)	FTB	84 (PSI)	FTB	108 (PSI)	FTB	
SAMPLE NUMBER	WELD DATE	LOCATION (SEAM #)	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	COMMENTS
DS-40	8/18/91	99-101	111	FTB			178	FTB	Third party peel 112, shear 158
DS-41	8/18/91	102-107	135	FTB			173	FTB	
DS-42	8/18/91	103-104	81	FTB			173	FTB	
DS-43	8/18/91	105-106	107	FTB			173	FTB	
DS-44	8/18/91	108-107	115	FTB			189	FTB	
DS-45	8/18/91	108-109	111	FTB			180	FTB	
DS-46	8/18/91	109-110	114	FTB			184	FTB	
DS-47	8/18/91	110-111	105	FTB			172	FTB	Third party peel 82, shear 157
DS-48	8/18/91	111-112	110	FTB			181	FTB	
DS-49	8/18/91	112-113	115	FTB			183	FTB	
DS-50	8/18/91	114-115	118	FTB			185	FTB	Third party peel 104, shear 152
DS-51	8/18/91	115-116	112	FTB			179	FTB	
DS-52	8/18/91	117-118	118	FTB			177	FTB	
DS-53	8/18/91	118-119	109	FTB			181	FTB	
DS-54	8/18/91	120-121	85	FTB			184	FTB	
DS-55	8/18/91	121-122	85	FTB			172	FTB	
DS-56	8/18/91	123-124	102	FTB			174	FTB	
DS-57	8/18/91	124-125	115	FTB			172	FTB	
DS-58	8/17/91	43-112	117	FTB			155	FTB	
DS-59	8/19/91	126-127	104	FTB			177	FTB	
DS-60	8/19/91	102-130	123	FTB			179	FTB	Third party peel 117, shear 155
DS-61	8/19/91	154-155	121	FTB			181	FTB	
DS-62	8/19/91	155-150	104	FTB			181	FTB	Third party peel 105, shear 180
DS-63	8/19/91	156-157	113	FTB			170	FTB	
DS-64	8/19/91	146-128	147	FTB			182	FTB	Third party peel 136, shear 181
DS-65	8/19/91	165-168	116	FTB			172	FTB	Third party peel 140, shear 178
DS-01	8/12/92	2-3	125	FTB	127	FTB	155	FTB	
DS-02	8/12/92	4a-5a	121	FTB	121	FTB	153	FTB	
DS-03	8/12/92	6-7	119	FTB	136	FTB	148	FTB	
DS-04	8/12/92	2-2a	139	FTB	150	FTB	153	FTB	
DS-05	8/13/92	7-8	119	FTB	123	FTB	157	FTB	
DS-06	8/13/92	8a-9a	122	FTB	125	FTB	158	FTB	
DS-07	8/13/92	9-10	121	FTB	122	FTB	155	FTB	
DS-08	8/13/92	10a-11a	120	FTB	128	FTB	154	FTB	
DS-09	8/15/92	12b-12c	140	FTB	141	FTB	166	FTB	
DS-10	8/15/92	12-13	128	FTB	117	FTB	171	FTB	
DS-11	8/18/92	14-15	126	FTB	129	FTB	175	FTB	
DS-12	8/18/92	17-18	126	FTB	125	FTB	155	FTB	
DS-13	8/18/92	13-14	142	FTB	127	FTB	165	FTB	
DS-14	8/18/92	15-16	125	FTB	106	FTB	162	FTB	
DS-15	8/18/92	16a-17a	132	FTB	131	FTB	163	FTB	
DS-16	8/18/92	18-19	119	FTB	108	FTB	159	FTB	
DS-17	8/18/92	19-20	132	FTB	109	FTB	161	FTB	
DS-18	8/17/92	20a-21a	125	FTB	123	FTB	162	FTB	

TABLE NUMBER A-5
SUMMARY OF DESTRUCTIVE TESTS ON WELDED GEOMEMBRANE SEAMS

PROJECT NAME: Lechner Brothers Landfill Closure, Phase I and Phase II
PROJECT NUMBER: 0182-001.10 and 0182.001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: R. Roberts
INSTALLER: Gagle 88,89 and Serrit 91,92
PRODUCT: 60 Mil Smooth and Textured HDPE

TEST			AVERAGE PEEL, SIDE 1	BREAK TYPE SIDE 1	AVERAGE PEEL, SIDE 2	BREAK TYPE SIDE 2	AVERAGE SHEAR	BREAK TYPE	
TEST			ASTM	ASTM	ASTM	ASTM	ASTM	ASTM	
DESIGNATION			D-413	D-413	D-413	D-413	D-3083	D-3083	
SPECIFIED VALUE			84 (PPI)	FTB	84 (PPI)	FTB	108 (PPI)	FTB	
SAMPLE NUMBER	WELD DATE	LOCATION (SEAM #)	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	TEST RESULTS	COMMENTS
DS-19	6/17/92	21-22	139	FTB	132	FTB	162	FTB	
DS-20	6/17/92	22-23	136	FTB	132	FTB	152	FTB	
DS-21	6/17/92	23-24	126	FTB	126	FTB	161	FTB	
DS-22	6/17/92	24a-26a	124	FTB	124	FTB	173	FTB	
DS-23	6/18/92	26-28	136	FTB	126	FTB	167	FTB	
DS-24	6/18/92	27-28	116	FTB	136	FTB	169	FTB	
DS-25	6/18/92	29-30	122	FTB	133	FTB	166	FTB	
DS-26	6/18/92	31-32	131	FTB	146	FTB	172	FTB	
DS-27	6/18/92	33-34	113	FTB	103	FTB	163	FTB	
DS-28	6/19/92	34-35	134	FTB	124	FTB	163	FTB	
DS-29	6/19/92	36-37	129	FTB	123	FTB	166	FTB	
DS-30	6/19/92	38-39	130	FTB	123	FTB	158	FTB	
DS-31	6/19/92	39-40	114	FTB	121	FTB	170	FTB	
DS-32	6/19/92	41-42	128	FTB	116	FTB	149	FTB	
DS-33	6/19/92	42-43	114	FTB	127	FTB	161	FTB	
DS-34	6/19/92	44-45	137	FTB	139	FTB	162	FTB	
DS-35	6/19/92	45-46	120	FTB	120	FTB	166	FTB	
DS-36	6/19/92	47-48	119	FTB	127	FTB	172	FTB	
DS-37	6/19/92	49-50	136	FTB	127	FTB	162	FTB	
DS-38	6/19/92	35a-36a	139	FTB	118	FTB	166	FTB	
DS-39	6/23/92	25a-26a	123	FTB	142	FTB	171	FTB	
DS-40	6/23/92	28a-29a	103	FTB	130	FTB	155	FTB	
DS-41	6/23/92	30-31	119	FTB	126	FTB	161	FTB	
DS-42	6/23/92	31a-32a	141	FTB	137	FTB	161	FTB	
DS-43	6/23/92	34a-35a	136	FTB	139	FTB	163	FTB	
DS-44	6/23/92	36-39	128	FTB	122	FTB	172	FTB	
DS-45	6/23/92	40a-41a	119	FTB	144	FTB	167	FTB	
DS-46	6/23/92	43a-44a	123	FTB	129	FTB	178	FTB	
DS-47	6/24/92	49a-50b	116	FTB	142	FTB	168	FTB	
DS-101	6/27/92	15-16	150	FTB	155	FTB	213	FTB	
DS-102	6/27/92	22-27	157	FTB	135	FTB	191	FTB	
DS-103	6/27/92	5-1	145	FTB	144	FTB	202	FTB	
DS-201	6/27/92	21-22	140	FTB	140	FTB	191	FTB	
DS-202	6/27/92	4-5	140	FTB	128	FTB	189	FTB	
DS-203	6/27/92	4-5	147	FTB	140	FTB	189	FTB	
DS-204	6/27/92	8-9	119	FTB	145	FTB	174	FTB	
DS-205	6/27/92	12-13	161	FTB	162	FTB	208	FTB	

TABLE A-6

SUMMARY OF HYDRAULIC CONDUCTIVITY TESTS

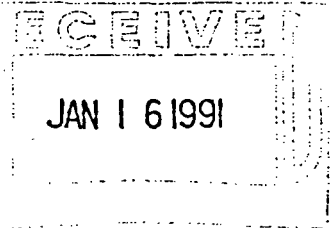
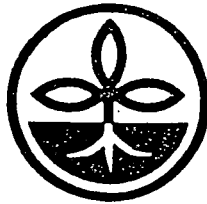
TABLE NUMBER A-6
SUMMARY OF HYDRAULIC CONDUCTIVITY TESTS

PROJECT NAME: Lechner Closure Phase I and Phase II
PROJECT NUMBER: 0182-01.10, 0182-001.38
OWNER: Lechner Brothers Land Reclamation

PREPARED BY: Mike Stewart
CHECKED BY: Nick Nickolas

SAMPLE NUMBER	PRODUCT	PERCENT PASSING # 200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PI (%)	SOIL CLASSIFICATION	HYDRAULIC CONDUCTIVITY (cm/sec)	REMARKS
203	Drainage Layer					SP	5.9×10^{-1}	Pre-Construction Testing, 1988
300	Drainage Layer	2.9				SP	5.9×10^{-2}	Construction testing, 1988-1989
301	Drainage Layer	2.9				SP	7.1×10^{-2}	Construction testing, 1988-1989
308	Drainage Layer					SP	7.1×10^{-2}	Construction testing, 1988-1989
308	Drainage Layer					SP	1.9×10^{-1}	Construction testing, 1988-1989
309	Drainage Layer					SP	2.9×10^{-1}	Construction testing, 1988-1989
335	Drainage Layer					SP	5.7×10^{-2}	Construction testing, 1988-1989
347	Drainage Layer					SP	1.4×10^{-1}	Construction testing, 1988-1989
348	Drainage Layer	7.1				SP	5.7×10^{-2}	Construction testing, 1988-1989
349	Drainage Layer	6.6				SP	3.1×10^{-2}	Construction testing, 1988-1989
	Drainage Layer					SP	2.0×10^{-2}	Bidder's submittals, 1991
	Drainage Layer					SP	2.0×10^{-2}	Bidder's submittals, 1991
DLR-1	Drainage Layer	1.3				SP	7.0×10^{-2}	Pre-Construction Testing, 1992
DLR-2	Drainage Layer	1.7				SP	9.0×10^{-2}	Pre-Construction Testing, 1992
DLR-3	Drainage Layer	4.8				SP	4.0×10^{-2}	Pre-Construction Testing, 1992
DLR-002	Drainage Layer	2.8				SP	3.0×10^{-1}	Pre-Construction Testing, 1991
CR-006	Drainage Layer					SP	1.0×10^{-1}	Sampled at source, 1991
CR-007	Drainage Layer					SP	2.0×10^{-1}	Sampled at source, 1991
CR-008	Drainage Layer					SP	2.0×10^{-1}	Sampled at source, 1991
CR-009	Drainage Layer					SP	1.0×10^{-1}	Sampled at source, 1991
DLR-001	Drainage Layer					SP	2.0×10^{-1}	Construction testing, 1992
DLR-002	Drainage Layer					SP	1.5×10^{-1}	Construction testing, 1992
DLR-118	Drainage Layer	3.6				SP	1.0×10^{-1}	Construction testing, 1992
DLR-20a	Drainage Layer	4.8				SP	1.0×10^{-1}	Construction testing, 1992
DLR-003	Drainage Layer	4.8				SP	1.0×10^{-1}	Construction testing, 1991
DLR-004	Drainage Layer	5.4				SP	7.5×10^{-2}	Construction testing, 1991
DLR-005	Drainage Layer	5.1				SP	1.0×10^{-1}	Construction testing, 1991
DLR-006	Drainage Layer	4.8				SP	1.5×10^{-1}	Construction testing, 1991

TOPSOIL LABORATORY ANALYSIS



15 January 1991
Lab. No. 37155
Northwest Office

SOIL AND PLANT LABORATORY, INC.

SWEET-EDWARDS/EMCON, INC.
18912 North Creek Parkway, Ste. 210
Bothell, WA 98011

LEICHTNER PROJECT S8201.010 - LANDFILL COVER

Soil Appraisal/Fertility Analyses: Current data indicate favorable pH/salinity conditions. Slightly low availabilities of nitrogen, phosphorus and boron are noted with otherwise favorable major and minor element nutrient conditions. Particle size distribution data indicate this soil to be sandy loam based upon USDA classification standards. The current organic matter content at 0.4 percent is considered low for a soil of this texture.

Based on current data fertility/physical improvements can be achieved by uniform broadcasting of the materials listed below followed by discing to a six to eight inch depth prior to planting:

AM'T/1000 SQUARE FEET

3 lbs.	Ammonium nitrate	
5 lbs.	Treble superphosphate (0-45-0)	
10 lbs.	Gypsum (calcium sulfate)	
3 oz.	Laundry Borax	Applied per above

Additional organic matter enhancement may be obtained by the uniform broadcasting of the following materials in addition to those listed above followed by rototilling to a depth of six to eight inches after placement of the topsoil:

AM'T/1000 SQUARE FEET

6 cu.yds.	Sawdust (2" layer) derived from fir or hemlock	
18 lbs.	Nitroform (38-0-0)	Applied per above

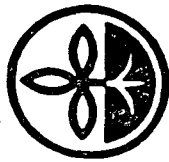
If you have any questions regarding this report please do not hesitate to contact the Bellevue office.

Sincerely,

DIRK W. MUNTEAN, M.A.

DWM/bsk

P.O. Box 6566, Orange, California 92613-6566 (714) 282-8777
Telex Number: 5101000505 ANSBK: Soil Plant SA
FAX Number: 714-282-8575
P.O. Box 153, Santa Clara, California 95052-0153 (408) 727-0330
FAX Number: 408-727-5125
P.O. Box 1648, Bellevue, Washington 98009-1648 (206) 746-6665
FAX Number: 206-562-9531



Soil and Plant Laboratory, Inc.

P.O. Box 6566, Orange, California 92613-6566/(714) 282-8777/FAX (714) 282-8575
P.O. Box 153, Santa Clara, California 95052-0153/(408) 727-0330/FAX (408) 727-5125
P.O. Box 1648, Bellevue, Washington 98009-1648/(206) 746-6665

SWEET-EDWARDS/ EMCON, INC.
18912 N. Creek Parkway, Ste 210
Bothell, WA 98011

SOIL FERTILITY AND
MICRONUTRIENT ANALYSIS
(A01 OR A17)

14 January 1991
Sample received: 8 Jan. 1991

JAN 16 1991

Sample #	Half Sat. %	pH	ECe	Parts Per Million Dry Soil							Sat. Extract		SAMPLE DESCRIPTION		
				NO ₃ -N	NH ₄ -N	PO ₄ -P	K	Ca	Mg	Cu	Zn	Mn		Fe	ppm
1	18	6.5	0.7	8	5	15	160	2660	464	1	2	6	48	0.13	Landfill Topsoil Leichter

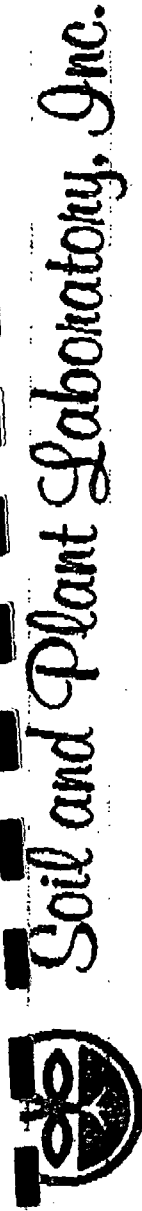
Half Saturation % = approx. field moisture capacity. ECe (mmhos/cm @ 25 deg. C.) by sat. extract method. Major elements by sodium acetate and sodium bicarbonate extraction. Micronutrients by DTPA extraction except boron by saturation extraction.

"#" means below the detection limit for the element.

SOIL APPRAISAL ANALYSIS (A03)

Sam ple #	Half Sat. %	pH	Ece	Org. %	% Retained (passing 2 mm screen)					SOIL CLASSIFICATION		
					Gravel		Sand					
					Coarse	Fine	Very Coarse	Med. to V. Fine	Silt Clay			
1				0.4	24.1	18.6	23.3	14.4	32.1	17.2	13.0	SANDY LOAM

Half Saturation % = Approximate field moisture capacity. ECe (mmhos/cm. @ 25 degrees C) - saturation extract conductivity. Gravel fraction expressed as percent by weight of sample as received. Particles sizes in millimeters.



P.O. Box 11744, Santa Ana, California 92711-1744/(714) 558-8333
P.O. Box 153, Santa Clara, California 95052-0153/(408) 727-0330
P.O. Box 1648, Bellevue, Washington 98009-1648/(206) 746-6665

SWEET-EDWARDS/EMCON, INC
18912 N Creek Parkway Suite 210
Bothell, WA 98011
Attention: Rodney Roberts

SOIL FERTILITY AND
MICRONUTRIENT ANALYSIS
(AO1 or A17)

Northwest Office
Lab No. 55646
LIECHNER PHASE II CLOSURE
S8201.38

Samples Taken: Samples Rec'd: 8/25/92

Sample #	Half Sat %	pH/Qual	NO3 N	NH4 N	PO4 P	Parts Per Million	Dry Soil	Ca	Mg	Cu	Zn	Mn	Fe	B	Na	Ext
----------	------------	---------	-------	-------	-------	-------------------	----------	----	----	----	----	----	----	---	----	-----

1	14	5.8	0.9	36	1.5	3	25	490	2070	440	2	2	15	123	0.96	
							1.8	6.0	2.2	4.1	4.9	1.5	3.7	9.1	3.2	

Sat SO4 = 0.5 me/l

8/27/92

Half Saturation % = approx field moisture capacity. Salinity = ECe (ds/m at 25 deg.C.) by sat ext method. Major elements by sodium chloride extraction (phosphorus by sodium bicarbonate extraction). Micronutrients by DTPA extraction (boron by saturation extraction). Interpretation guide below each element (1.0 = predicted sufficiency level for average fertility requiring crops).

TEC (listed below Half Sat. when requested) = Estimated Total Exchangeable Cations in milliequivalents per kilogram (meq/kg)

Northwest Office
Lab. No. 55646

LIECHNER PHASE II CLOSURE ANALYSES

Accompanying data indicate a moderately acid reaction or pH with salinity favorably low. All major and minor elements are in optimum supply ranges. The only exception is sulfate which is low. Additional sulfate availability can be achieved by uniformly broadcasting 10 or 15 lbs. gypsum (calcium sulfate) per 1000 square feet which can either be incorporated by rototilling or followed by irrigation/rainfall.

Please let us know if any questions arise regarding this report.

Sincerely,

W. Muntean

W. MUNTEAN, M.A./bsk

APPENDIX B

GEOMEMBRANE PANEL LAYOUT DRAWINGS

APPENDIX C
RECORD DRAWINGS

APPENDIX D

ADDITIONAL INFORMATION AND SURVEY DRAWINGS